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Plant Presentability

IT MAY be true, as Gilbert says, that "things are seldom what they seem," but all the same, the man who decides things, who adopts measures and selects men, must be guided by qualities and conditions as they appear to him.

And so, when he is looking about for a man, it is the well-groomed, likely looking and presentable person who will attract him.

He will, or should look well beneath the surface and check up on record and accomplishment, but the man who is well-kept and able to make a good impression when interviewed will get chances that others, perhaps more competent but less presentable, will miss.

The same thing applies to one's surroundings; to one's plant if one is a power-plant engineer.

I have read of a man who became a great railroad executive. He was a small-town station master, but he kept the station in such apple-pie order and made the surroundings so attractive that officials noticed it, looked him up, put him in charge of greater things, and he found the way up.

The Big Boss likes to see things look nice. He will have more interest in his power plant and more respect for the man who runs it if it is shiny and shipshape and quiet and well-kept.

He probably would not O. K. a requisition for ferns and rugs, but he will appreciate clean paint, polished bright-work, freedom from noise and leaks, and he will more than likely be sympathetic with and contributory to a disposition to clean up.

The man who runs an engine room spends the greater part of his waking hours in it. Why should he not be interested in making it a nice place in which to stay, a place that he can show to his friends with pride, and a place into which the owner will not be ashamed to bring a visitor?

I do not mean that an engineer should make a janitor of himself, but if the office notices that he manages his department conspicuously well, they may look his way when opportunities for greater responsibilities offer.

F. R. Low

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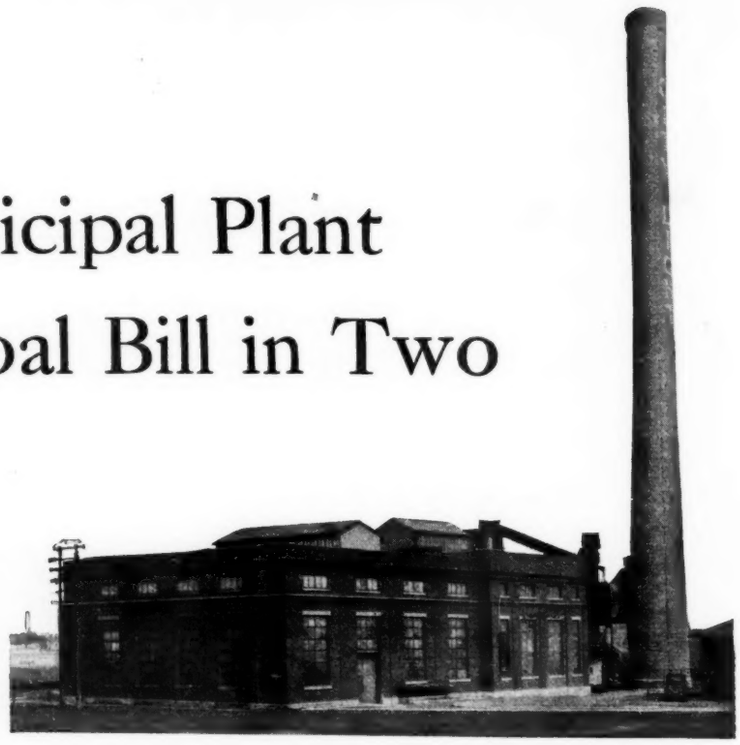
Remodeling a Small Municipal Plant Cuts Coal Bill in Two

By Charles A. Hamilton*

Enlargement and remodeling of 3,000-kilowatt plant reduces the coal rate per kilowatt-hour from 3.5 to less than 2 pounds



FIFTH Street Station, serving the City of Holland, Mich., has been rebuilt recently to provide capacity for increasing loads. This station has been the only source of power for the city, including street lighting, commercial light and power, and power for pumping city water obtained entirely from deep wells. The electric utility business is conducted by the Board of Public Works, their jurisdiction embracing also the supply of water for all purposes, a sewage treatment plant and a system of collecting sewers. No outside assistance was required in financing the improvements, as the entire cost of the reconstruction was paid for out of the accrued earnings of the electric business.

Early in 1925 it was decided that in order to be equipped properly to handle the increasing load on the station and to retire the older boilers, a general program for the reconstruction of the boiler room must be started. At this time the plant consisted of four 3,000-sq.ft. inclined water-tube boilers and three steam turbines having an aggregate capacity of 3,000 kw. operating on saturated steam at 150 lb. pressure. The three steam turbines were rated at 500, 1,000 and 1,500 kw., respectively, which provided a plant capacity of only 1,500 kw., with the largest unit out of service. During the year 1925 the peak load on the station exceeded this capacity by about 38 per cent, which was not a favorable condition for a plant furnishing the entire electric requirements of a city.

*Burd, Giffels & Hamilton, Engineers, Grand Rapids, Mich.

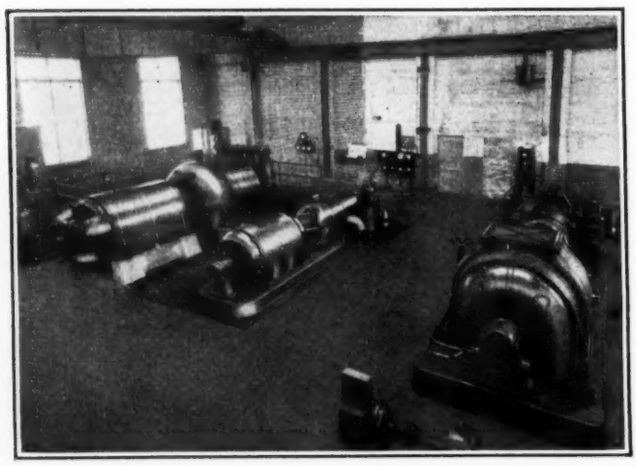


Fig. 1—Turbine room with new 2,500-kw. unit at left

New Construction Accomplished Without Service Interruption

Owing to the fact that continuous service was required of the plant, any schedule for replacement had to be worked out in such a manner as to permit the plant to carry the regular load at all times during the construction program. Several preliminary studies led to the final decision to construct an entirely new boiler room of modern design of such dimensions as to inclose the old boiler room building and equipment on one side of the firing aisle and install two new 5,000-sq.ft. units on the opposite side of the house. This boiler plant, having floor space for four 5,000-sq.ft. boilers, was completed in 1926.

It was decided to design the new boiler plant for the present installation of four and an ultimate capacity of eight boilers. The first battery presented unusual construction problems, as the new boilers were to occupy space adjacent to the old boiler room, and, with a sandy soil, great care had to be exercised to protect the boilers in operation while excavating for the new basement. The circulating water system, consisting of the intake and discharge wells and the connecting piping to the units in the turbine room, presented difficult obstruc-

tions to the work, as these lines had to be kept in operation during the entire reconstruction. In designing the new coal-handling system, which utilized the existing siding and concrete coal pocket, arrangements to serve the existing four boilers during construction had to be worked into the program.

A building of brick and steel with concrete foundations, measuring in plan 66 ft. 6 in. by 43 ft. and 39 ft. high from the firing floor to the roof, was erected. It contains 111,500 cu.ft. of space, which, with two batteries of boilers, one on either side of a central firing aisle, will give 5.65 cu.ft. per square foot of boiler heating surface. Special study was given to daylight illumination by eliminating the usual coal bunker from the firing aisle and installing 463.5 sq.ft. of skylight directly over the aisle. The side walls also are provided with ample window area to give good lighting above and to the rear of the boiler units, and aisle floors at the rear of the boilers are equipped with units of three-way prism glass to light the ash runway in the basement.

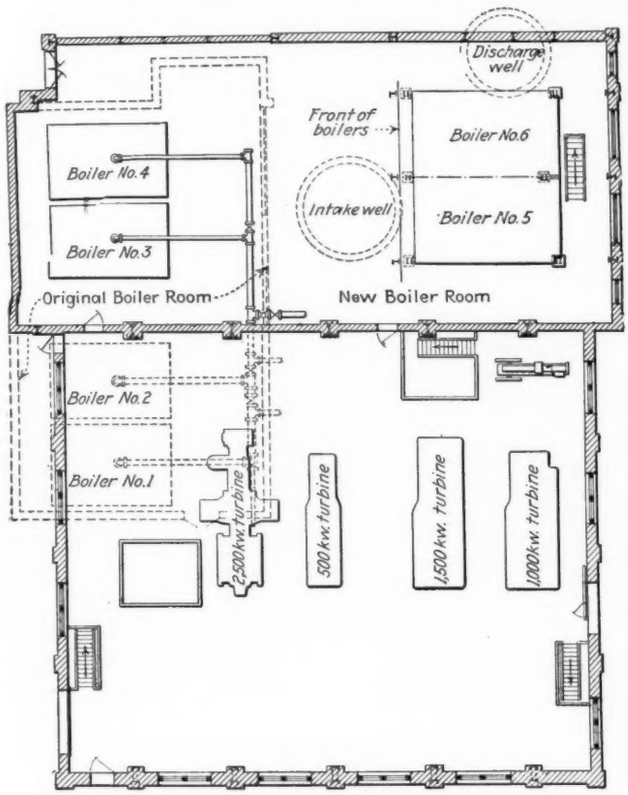


Fig. 2—Plain, dotted lines show location of old boiler room

Stack Supported on Piles

A radial brick chimney 10 ft. in diameter and 200 ft. high is adjacent to the boiler house. Tests made after the excavation was finished indicated that the sandy soil would not permit a unit loading sufficient to support it, so 123 twenty-foot oak piles were driven in the foundation area and capped by the concrete stack foundation below the ground water line. These were the only supporting piles used in the station, the equipment and building foundations resting on spread footings.

The station is served by a siding from the Pere Marquette Railroad for receiving shipments of coal. The outside coal storage consists of a concrete coal pocket having a capacity of 500 tons, supplemented by yard storage from a bucket elevator. Coal as received in railroad cars is dumped into a 10x12-ft. steel track hopper from which it is taken by a 24-in., 15-ft. apron conveyor to a 24x24-in. single-roll coal crusher that is belt driven by a 10-hp., 900-r.p.m. motor. The crusher discharges into a vertical bucket elevator operating on 60-ft. centers. From the head of the bucket elevator the coal may be shunted through a swivel chute to outside ground storage, or discharged to a 16-in. by 50-ft. outside belt conveyor serving a 75-ton steel bunker located on the center line of the firing aisle, just outside the boiler room. Coal is dropped from the bottom of the bunker directly to a 1,000-lb. hand-operated weigh larry from which it is served to the extension stoker hoppers.

For reclaiming coal dropped into the concrete coal pocket, a 20-in. by 100-ft. belt conveyor has been installed along one wall of the pocket. This conveyor discharges into the crusher hopper from which point the coal is carried to the boiler room in the regular way. The coal handling equipment has a guaranteed capacity of 36 tons an hour. When the future boiler room extension is constructed, it will be necessary to relocate the railroad siding, but it may continue to serve the present track hopper and equipment in practically the present location. At this time the outside belt conveyor will be abandoned, and the 75-ton bunker moved to a position adjacent to the bucket elevator. The ultimate coal-handling plant will include a yard storage served by a drag scraper outfit.

Largest Permissible Boiler Selected

The consideration of the proper size of boiler unit to adopt was based upon special conditions which obtained in the operation of the plant over a considerable period of time. These conditions required a unit of such capacity as would permit one boiler being down all the time for repairs or cleaning, and such that one unit would adequately carry the night load, which is comparatively light. Against these requirements the selection was made of the largest unit permissible.

Stirling bent-tube boilers, each containing 4,937 sq.ft. of heating surface, furnish steam at 250 lb. gage. Two units were installed in 1926, while the third unit is now under construction. Superheaters having 340 sq.ft. of surface per unit give 100 deg. of superheat at 150 per

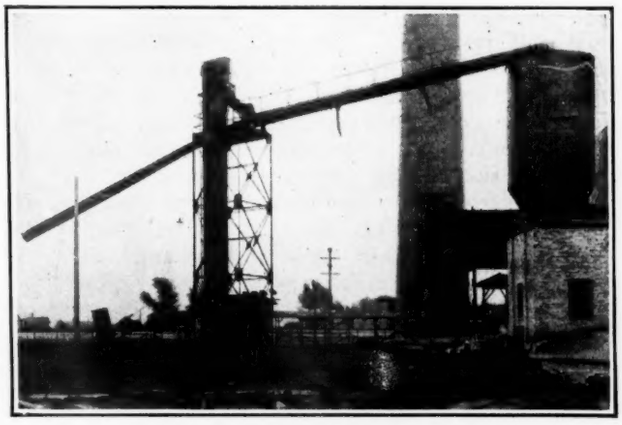


Fig. 3—Coal handling equipment

cent rating. They are of the bent-tube convection type and located between the first and second passes of the boiler. The settings are lined with firebrick. The bridge and front curtain walls are built entirely of first-quality firebrick. The upper front and side walls have one course of insulating brick. To accommodate the length required by the stokers, a short horizontal flat arch extends from the front drum to the front wall. Six soot-blower elements are installed, and each boiler is provided with a multipointer draft gage and steam flow meter.

Underfeed stokers having five retorts and 91 sq. ft. of projected effective area are capable of operating the boilers continuously at 275 per cent rating or at 300 per cent for short intervals, when burning eastern Kentucky or West Virginia coal. The ash discharge dump plate is steam operated and drops the ashes into the receiving hopper of a hydro-jet ash sluice in the boiler-room basement. The stokers are driven by individual 5x7-in. vertical steam engines, interconnected so that one engine may drive two stokers when necessary.

The forced-draft system consists of an individual fan and duct for each boiler. Each fan delivers 24,000 cu.ft. of air per minute at 6-in. static pressure, and is driven by a 50-hp. 2,400-volt slip-ring motor. The forced-draft air ducts, built of $\frac{3}{16}$-in. steel plate, are interconnected with dampers between units. Air for combustion may be drawn from the basement of the turbine room through a duct discharging the generator cooling air, or through a hatchway from the firing floor.

The generating capacity has been increased by the installation of a 2,500-kw. two-phase 60-cycle 3,600-r.p.m. turbine unit arranged for extraction bleeding for feed-water heating. Through an expansion joint the turbine is connected to a 4,000-sq.ft. surface condenser and the entire unit, including the condenser, rests on a reinforced concrete foundation built independent of the building structure. The condenser is served by two circulating pumps rated at 2,500 and 4,000 gal. per min. The smaller pump will maintain the vacuum in winter operation and will carry the unit at full load in summer at a lowered efficiency, while the 4,000-gal. pump is required for full-load summer conditions. Owing to the fact that the unit operates on fractional loads for a considerable percentage of the total time, this arrangement of pumps was selected. All condenser auxiliaries are motor driven except the air pumps, which consist of twin steam ejectors mounted on a common inter and after condenser, each unit having capacity to remove 22.2 lb. per min. of dry air at 2 in. of mercury.

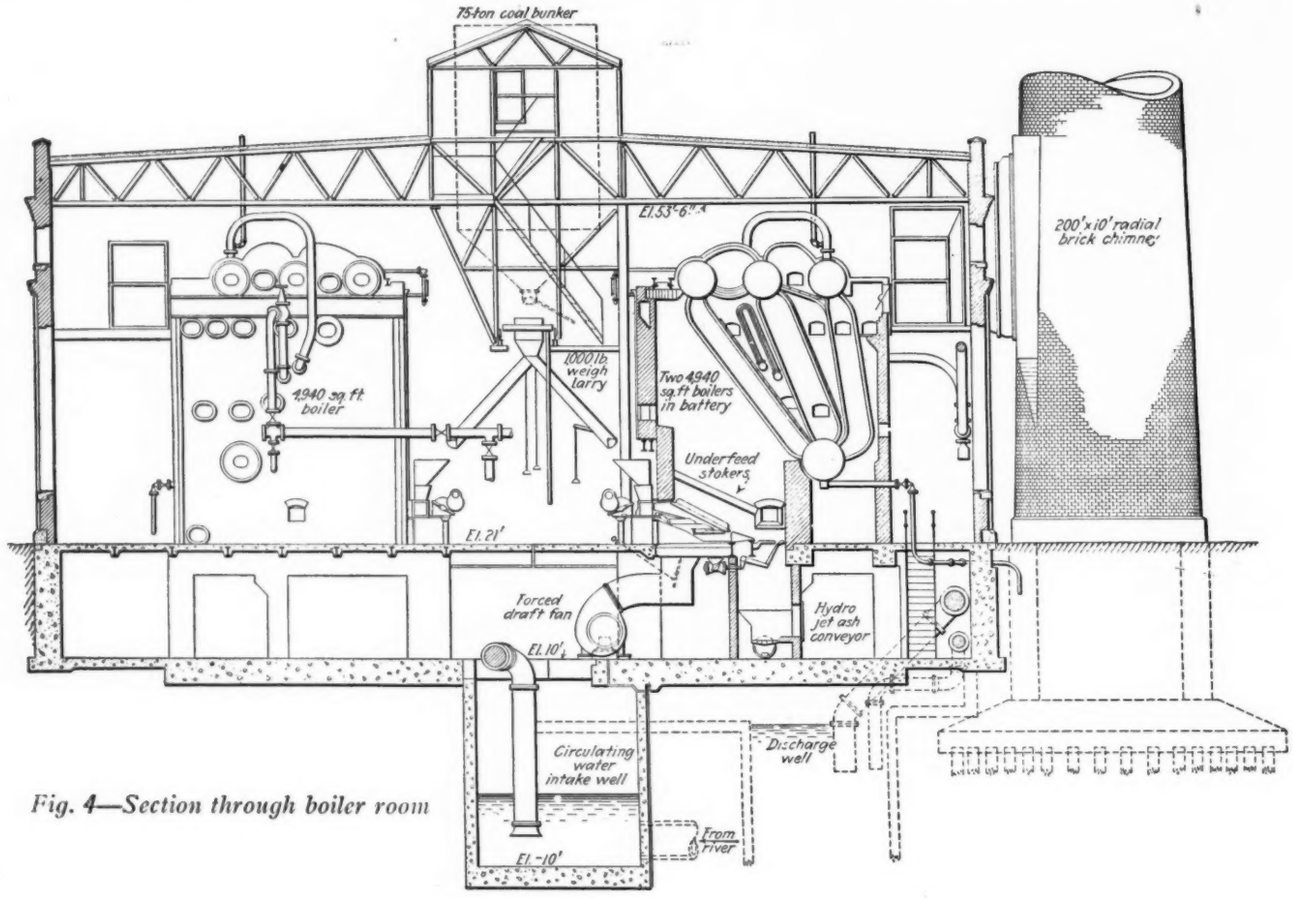


Fig. 4—Section through boiler room

The condensate pumps discharge through the air ejector condensers to an open feed-water heater having a capacity of 88,000 lb. per hour. Exhaust steam for feed-water heating is available from a turbine-driven exciter, the boiler-feed pumps, stoker engines, and the circulating pump engine on the 1,000-kw. unit. When additional steam is required for feed-water heating, steam may be extracted from the 2,500-kw. turbine.

As the installation of the new boilers with superheaters resulted in a much higher total steam temperature than had been used, the entire high-pressure steam piping

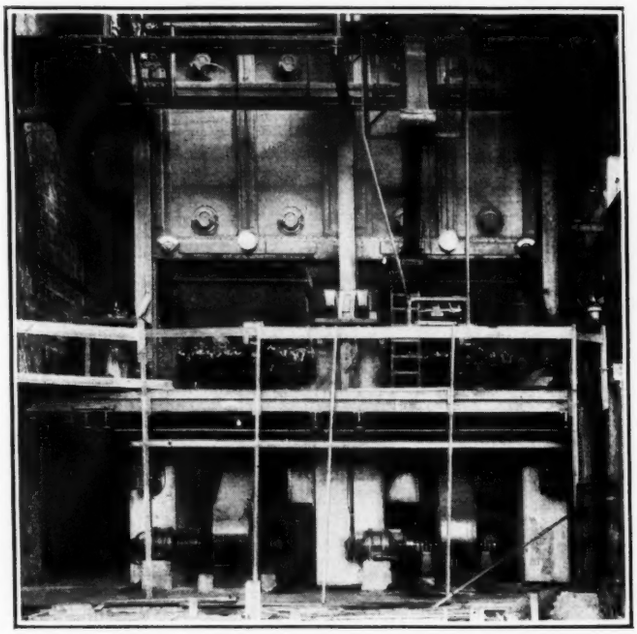


Fig. 5—View of new boilers

system required replacement. All new fittings are of cast steel and pipe flanges 4½ in. and larger are of the "VanStone" type. The main steam header is 10 in. in diameter. Feed-water, blow-off and high-pressure drip lines also have cast-steel fittings.

Being low and level, the area adjoining the Black River provides a natural disposal for several years' accumulation of ashes. The ashes are handled by a hydro-jet system using a sluiceway below the ashpits served by high-pressure water jets that deliver the mixed water and ash to a sump. From this receiving sump the mixture is pumped by a special manganese-lined centrifugal pump to the disposal yard adjacent to the plant.

The average coal per kilowatt-hour for the four-year period ending 1925 was 3.5 lb.; for 1926 it was 2.98 lb.; during which time the new boilers were put in operation at 150 lb. gage and 100 deg. superheat. The steam pressure was raised to 240 lb. on May 5, 1927, and for the last few months the records indicate an annual average coal rate for the new plant slightly over one-half the old rate, or less than 2 lb. per kilowatt-hour.

Roy B. Champion, superintendent of public works, had charge of the project. Burd, Giffels & Hamilton, consulting engineers, Grand Rapids, Mich., designed and planned the reconstruction and supervised the work.

NEW EQUIPMENT IN FIFTH STREET STATION — HOLLAND, MICH.

Capacity, present, kw	5,500
Capacity, ultimate, kw	10,000
Boilers, 3, Stirling, 4,937 sq.ft.	Babcock & Wilcox Co.
Pressure, lb. gage	250
Superheat, deg. F	100
Steam temp., deg. F	506
Ratio water heating surface to grate area	54
Furnace volume, cu.ft.	1,670
Cu.ft. of furnace volume per sq.ft. of grate area	18.3
Superheating surface per boiler, sq.ft.	340
Stokers, Taylor underfeed, five retort	American Engineering Co.
Grate surface, projected, sq.ft.	91.1
Dump plate	Steam operated
Drive	5x7-in. Troy vertical engines
Fans, forced-draft, 3	Buffalo Forge Co.
Capacity each, cu.ft. at 6 in. stat. press	24,500
Drive	50-h.p. 600 to 1,200 r.p.m. G. E. slip-ring motor
Coal	Eastern Kentucky and West Virginia
Coal handling system, 36 tons per hour	Newaygo Engineering Co.
Steel, bunker, capacity, tons	75
Weigh, larry, hand-operated, lb	1,000
Crusher, 24x24-in., single roll	Jeffrey Mfg. Co.
Ash handling, hydro-jet system	Ailen-Sherman-Hoff Co
Turbine-generator, 2,500 kw., 2-ph. 60-cycle, 3,600-r.p.m.	General Electric Co.
Condenser, two-pass 4,000 sq.ft. surface	Elliott Company
Circulating pumps, two, gal. per min	4,000 and 2,500
Drive	40 and 15 h.p. G. E., 2,400-v., 2-ph. motors
Vacuum pumps	Elliott combination type *C* ejector
Condensate pumps, two, driven by 5 hp. motors, 3,450 r. p. m.	
Feed water heater, open, 88,000 lb. per hr. Worthington Pump & Machinery Corp.	
Boiler feed pumps, two Cameron, 150-g.p.m., turbine driven, and one Worthington duplex, 10x6x12-in.	
Exciters: One Westinghouse 50 kw., 125-v., 1,750-r.p.m., turbine drive; one General Electric 25-kw., 120-v. 1,200 r.p.m., motor drive; one Allis-Chalmers, 12-kw., 112-v., 500 r.p.m., motor drive.	

MISCELLANEOUS EQUIPMENT

Feed-water regulators	Swartwout Co.
Non-return valves	Lagonda Mfg. Co.
Soot blowers	Diamond Power Specialty Corp.
Draft gages	Bailey Meter Co.
Steam flow meters	Bailey Meter Co.
CO_2 recorders	Hayes Corporation
Traveling screen	Chain Belt Co.
Reinforced concrete intake pipe	LaMar Pipe & Tile Co.
Breeching and forced-draft ducts	Muskegon Boiler Works
Gratings and walkways	Irving Iron Works Co.
Structural steel	G. R. Steel & Supply Co.
Piping	Pittsburgh Piping & Equip. Co.
Pipe covering	Philip Carey Co.

THE FIRST DEVELOPMENT IN AMERICA OF STEAM WELLS, where the earth is tapped for natural heat promises to deliver power in paying quantities. This development is at "The Geysers," in California, near San Francisco. Eight wells have been put down to depths of between 200 and 650 ft. and produce steam pressures of between 60 and 275 lb. per sq.in. Quantitative measurements of four of the wells show a steam output equivalent to 4,500 kw., or over 1,000 kw. per well. The sinking of these wells does not seem to diminish each other's activity, although two of them are within 50 ft. of each other. In fact, all the wells have shown an increase in both the pressure and temperature of their steam for a certain period after being opened. The California wells have one advantage over a similar development on a larger scale at Larderello, Italy, in that the Larderello steam contains corrosive acids and necessitates elaborate purifying before it can be used, whereas the California wells yield a steam whose acidity is so low that it can be used in its natural state.—*The Valve World.*

Vibration of Turbine-Generator Foundations

By Thomas C. Rathbone
Engineer, Westinghouse Electric & Manufacturing Company

THIS article points out that the customary efforts to avoid resonance by design are quite insufficient, that most structures are too complex to predetermine the many modes of vibration, and that many harmful or beneficial features affecting smooth running are too often overlooked.

FOR heavy rotating machinery, it is not sufficient to design a foundation which merely insures that the stresses due to the static and assumed dynamic loading fall within the limitations of a conventional factor of safety. It is quite generally recognized that additional precautions must be taken to avoid natural structural frequencies coinciding with the normal speed of the rotating element. The phenomenon of resonance is too generally understood to warrant an analysis of the fundamental principles here. Briefly summarized, any elastic system possesses natural modes of vibration, each with its own particular frequency. If a periodic force approaching one of these frequencies is imposed on the system, the effect is cumulative. The vibratory displacements then become greater and greater until internal friction is able to balance the energy input from the periodic force. Thus small forces near a critical frequency may result in an inordinately large vibratory amplitude.

The analysis of resonance in the many modes of vibration possible in a complicated system is not so generally understood; at best, computations dealing with such systems become exceedingly tedious.

In the attempt to avoid resonant conditions in connection with turbine-generator apparatus, it has in the past been specified that deflections of the rotating elements and supporting structures fall within certain limits regulated by the operating speed of the unit. These values were arrived at through calculations based on broad assumptions, and on the principle that natural frequencies are functions of weight deflections.

Residual Unbalance in Operation

If perfect balance were possible, resonance would not concern us. On the other hand, a rotor badly out of balance would probably shake almost any kind of installation. It is naturally the duty of the turbine builder to eliminate unbalance as far as is humanly possible. To accomplish this, all rotors are balanced in supersensitive dynamic balancing machines, but there will always be a residual unbalance. The best materials and most modern processes are not perfect; some residual thermal strain, for example, may persist. Resulting eccentricities in shape, which barely can be detected, may require a pound or so for the balance correction. The tolerance requirement for balance is much more rigid than the most exacting tolerance laid down for machining. For example, it would appear that a limit of machining error of 0.002 in. for the body of a large turbine spindle is rather stringent, yet the possible eccentricity of 0.001 in. which may result, would, for a rotor weighing 100,000 lb., cause an unbalance of 100 inch-pounds and require a total of 4 lb. at a radius of 25 in. for its correction. Actually, these spindles are balanced in terms of ounces. Small eccentricities from thermal causes that hardly can be measured may therefore become evident through the unbalance produced. Thus may be seen how changes in balance may occur in operation. These changes are too small to detect on most installations, but on some an approach to a resonant condition may allow the shift in balance, due to temperature changes, to manifest itself as a real and objectionable vibration, sometimes of a transitory nature.

Vibration Studies

The turbine-generator builder has been actively engaged in research on the problem of vibration in operation. Sensitive vibration-measuring instruments have been developed, and analytical methods for determining the amount and location of unbalance have been reduced to a practical basis. By one of these methods it is possible to calculate the amount and location of the unbalance in a rotor by data obtained from two test runs. These methods are new in the art and were explained in the Feb. 7 and 14 issues of *Power*.

The article on "Field Balancing Rotors at Operating Speed" appearing in the Feb. 7 issue, described and illustrated a portable vibrometer arranged so that it can be adjusted to show the components of vibration in any direction in space. A modification of the vibrometer has been developed, employing a microscope with a graduated eyepiece held stationary by the pendulum and using a small pin-hole objective that vibrates with

the structure. When observing a transmitted point of light through the pinhole, the path of the vibratory motion appears as an illuminated figure.

In Fig. 1 illustrations *a* to *e* show common types of motion encountered. Fig. 1 *b* is most usual, while *d* is essentially a three-dimensional type, produced by a fundamental ellipse lying, not in a plane, but on the surface of a cylinder, which explains the saddle-shaped figure.

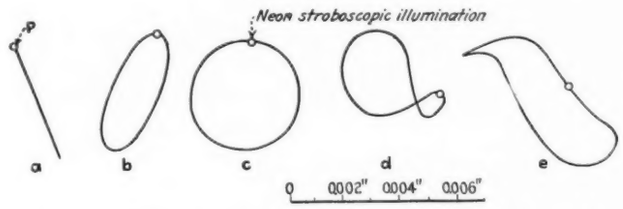


Fig. 1—Common types of vibrations observed with vibrometer

The cusp in Fig. 1 *c* indicates an impactive interference. This type of figure usually accompanies a sharp, hard vibration, which to the senses may "feel" much worse than larger amplitudes with sinusoidal motion. Changes in the shape and inclination of the figures during operation indicate changes in the elastic characteristics of the installation due to shifting of the loading or other cause. For example, the axis of an ellipse has been observed to make slow oscillations or rotations, in keeping with some change in the elastic properties of the system.

Modification of Vibrometer

A further modification of the vibrometer has been developed, employing stroboscopic illumination (interrupted illumination) of the pinhole objective in conjunction with a steady illumination. A neon lamp is caused to flash once a revolution at a known instantaneous rotor position. This position is controlled by manipulating a dial, which, for convenience, is graduated in accordance with the numbered balance plug holes on the rotor. It is also possible to obtain a direct reference by observing balance hole numbers stamped on an exposed part of the shaft. By means of this apparatus, a particular point, as at *P*, Fig. 1 *a* to *e* stands out stroboscopically in the characteristic pink neon color. The phase relation between points on the vibration figure relative to the rotor is then known. This apparatus is arranged to be driven either by a synchronous motor or by attaching it to the end of the shaft itself.

Instruments are now available that will record the vibratory stresses in any part of a structure, as well as apparatus for recording both motion and frequency of vibration.

By these means we are enabled to determine the complete characteristics of vibratory motion—its frequency, magnitude, path and plane of motion, and its phase relation to the rotating element.

Assuming that amplitudes are a measure of unbalance, a polar diagram may be plotted, showing unbalance and its direction, with reference to a datum on the rotating element.

Fig. 2 is such a chart, showing the migration of the unbalance from the time the unit went on the line until normal conditions were reached. The reason for the loop often encountered is not clear, but it is thought that gyroscopic precession may play some part.

It was during these investigations that certain remarkable features of vibration were encountered, giving to the property of resonance an importance not heretofore appreciated. With the information now obtainable, the widely differing vibratory response on various installations from given amounts of unbalance has been demonstrated in a decisive way.

Predetermination of Natural Frequencies

Manufacturers of turbine-generator apparatus seldom supply or erect the foundations. The manufacturer usually furnishes the foundation designer with data covering the outline of the proposed unit, details of soleplates, dead and live load and torque reactions, the speed of the unit, and certain deflections to avoid. From these data the foundation designer is expected to develop a structure that will safely carry the loads to be imposed, provide sufficient rigidity against lateral disturbances and possess natural frequencies remote from the running speed of the unit. The design is usually submitted for criticism to the turbine-generator manufacturer, who checks the important stresses, clearances, dimensions, etc., and, based on broad assumptions, the fundamental frequencies under the main supports, at least in the vertical direction. He then may make suggestions as to the alterations appearing desirable.

In spite of these precautions resonance is sometimes encountered where least expected. We are, therefor, faced with the necessity for gaining a more thorough

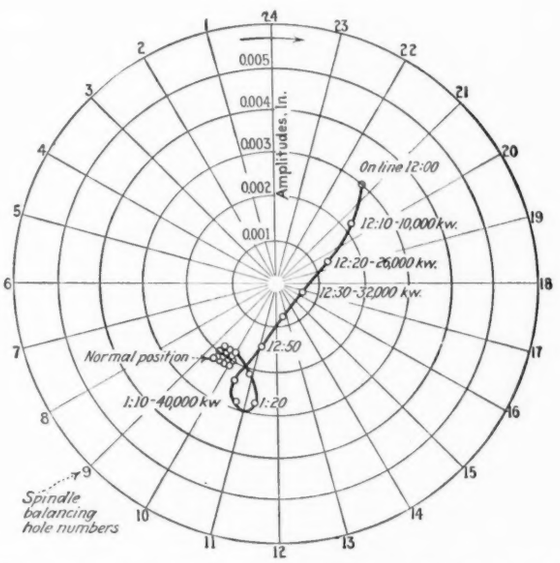


Fig. 2—Migration of vibration amplitudes during starting-up period

knowledge of the problem of vibration in complex structures in order to prevent recurrences of this nature.

All foundations lie between two extreme conditions—the one with bearings held rigid, as in bedrock, and the other with the bearings supported in a perfectly flexible manner, as by cables from the roof. In neither case could vibration of any magnitude develop. As soon as intermediary elastic structures are brought into play, there is introduced the possibility of magnification of the vibratory motion.

In such a structure the resonant vibration character-

istics are affected by the inertia and elastic deflection of every part that undergoes vibratory motion, from the rotor itself all the way down to the mat and subsoil.

A foundation structure cannot be considered as having certain inherent vibration characteristics *in itself*. Nor can vibratory attributes with regard to critical speeds, resonance, etc., be assigned the turbine-generator unit. It is the combination of the two which determines what the resonance or other characteristics shall be. To speak of natural frequencies in the one as a complete entity, without regard to the other, is meaningless.

The deflections controlling resonance in machine parts are sometimes quite small in comparison with the over-all structural deflections. The machinery, therefore, does not necessarily have a major part in fixing the resonance characteristics of the whole, except so far as mass is concerned.

The rotating element is designed to possess a certain stiffness or rigidity which is characterized by its static deflection. It happens that this deflection corresponds to a particular critical speed, with the assumption of rigidly supported bearings. This critical speed is merely an indication of stiffness, and is not by any means the actual critical speed in the installation. The foundation deflections are often several times greater than the rotor deflection, profoundly affecting the fundamental and higher critical speeds. The rotor deflection is used as a basis for fixing the over-all deflection in attempts to avoid resonance.

How Mass and Elasticity Affect Natural Frequencies

The model, Fig. 3, illustrates, in a simple way, the manner in which the addition of masses and elasticity affects the resultant natural frequencies.

The spindle mass is represented by the weight A and its elastic scale by the spring P. The mass of the cylinder and foundation is represented by the weights B and C with the bar, and the elastic scale by the springs Q and R. The spindle mass alone, suspended by its spring from a rigid bracket, vibrates at the rate of 140 cycles per minute. This corresponds to the "calculated" critical speed, with assumed rigidity at the bearing supports. The cylinder and foundation systems with the spindle mass removed vibrated in the fundamental vertical direction at the rate of 148 cycles per minute. When the spindle mass is supported by the foundation, as shown in the model, the fundamental natural frequency of the system becomes 96 cycles per minute, and cannot be made to vibrate freely at either 140 or 148 cycles per minute. There is also a second mode of vibration, in which the spindle mass is moving one way, while the cylinder and foundation mass is moving in the opposite direction. The frequency of this mode is about 200 cycles per minute. The spindle spring has a node or dead coil at about the position indicated, and for all purposes the spring could be cut off and supported at this point with no change in frequency.

There is still another mode in which this simple system may vibrate freely. The two masses representing stator and foundation weights may move in opposite directions, seesaw fashion, with the spindle mass center remaining relatively immovable. This takes place at about 156 cycles per minute.

Thus the original spindle critical speed has lost its identity in the act of supporting the spindle on the foundation structure. Different frequencies from those enumerated for the model would obtain if the masses or scales were varied.

If the turbine-generator installation could be reduced to such a simple system, comprising a rotor mass with its spring scale supported by a concentrated stationary mass with its own spring scale, then some approximation might be computed to cover the two fundamental critical speeds resulting.

The critical speed of the rotating element, assuming rigid support, is customarily calculated to a fair degree of accuracy. It is convenient, therefore, to state the combined-system criticals as coefficients of this known rotor critical speed.

In Fig. 4 a chart is given showing the interrelation of masses and scales and resulting frequencies. The

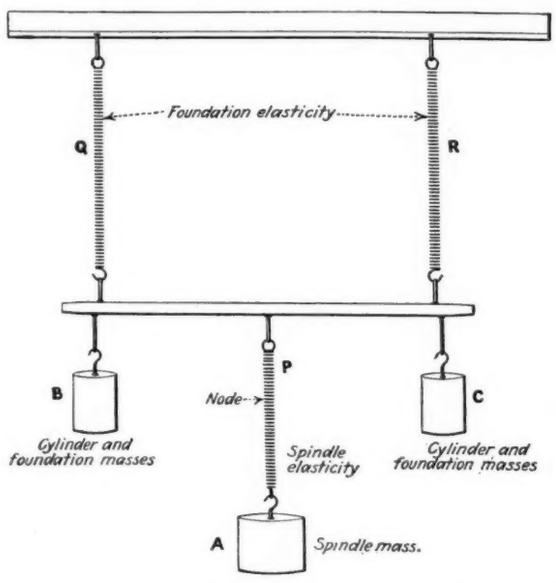


Fig. 3—Model illustrating mass and elasticity of a turbine unit and its foundation

diagram is not logarithmic, but purposely distorted to enlarge the area at unity ratios. The ratio of the spindle scale to the foundation scale is used as absissa and for the ordinate the ratio of spindle mass to stationary mass is taken. Having given the scale and mass ratios, a point is fixed on the chart from which the two critical speed coefficients are read off. The solid family of lines is for the lower critical, and the broken lines are for the upper critical speeds. Knowing W_2, the calculated critical speed of the rotor alone, the actual two critical speeds of the combination, W'_c the upper and W''_c the lower, are determined. The critical speed of the rotor alone always falls between the upper and lower critical speeds of the combination.

The chart may also be of use when all but the foundation scale is fixed. Thus, under these ideal conditions the elastic deflection of the foundation could be determined, which insures the two combination criticals being at specified percentages away from the operating speed.

A further practical use of such a chart is to be had when, for instance, resonance is encountered and it is desired to know what best to alter to relieve the situation. The disposition of the coefficient lines at the local-

ity fixed by the existing scale and mass ratios would indicate which way to alter either of these ratios to produce the maximum result.

The seesaw mode of vibration described for the model is more difficult to evaluate, as the location of the spindle center of mass and the ratio of the two stationary masses become factors.

It may be taken for granted that it is extremely difficult to attempt a rigid solution of this problem. The simple system illustrated by the model and the chart involves a bi-quadratic equation of twelve terms. As amples of the difficulties encountered in analytical treatment may be cited.

At the very outset all elastic calculations are vitally dependent on the value of the modulus of elasticity. For steel, the value of 29 or 30 millions is almost invariably assumed throughout the structure as if it were a continuous piece of metal. Experiments show that the modulus in compression of a column built up of a stack of plates may be only a fraction of the value for a solid piece. Repeated imposition of loading tends eventually to stabilize the value. The fact that the elastic modulus

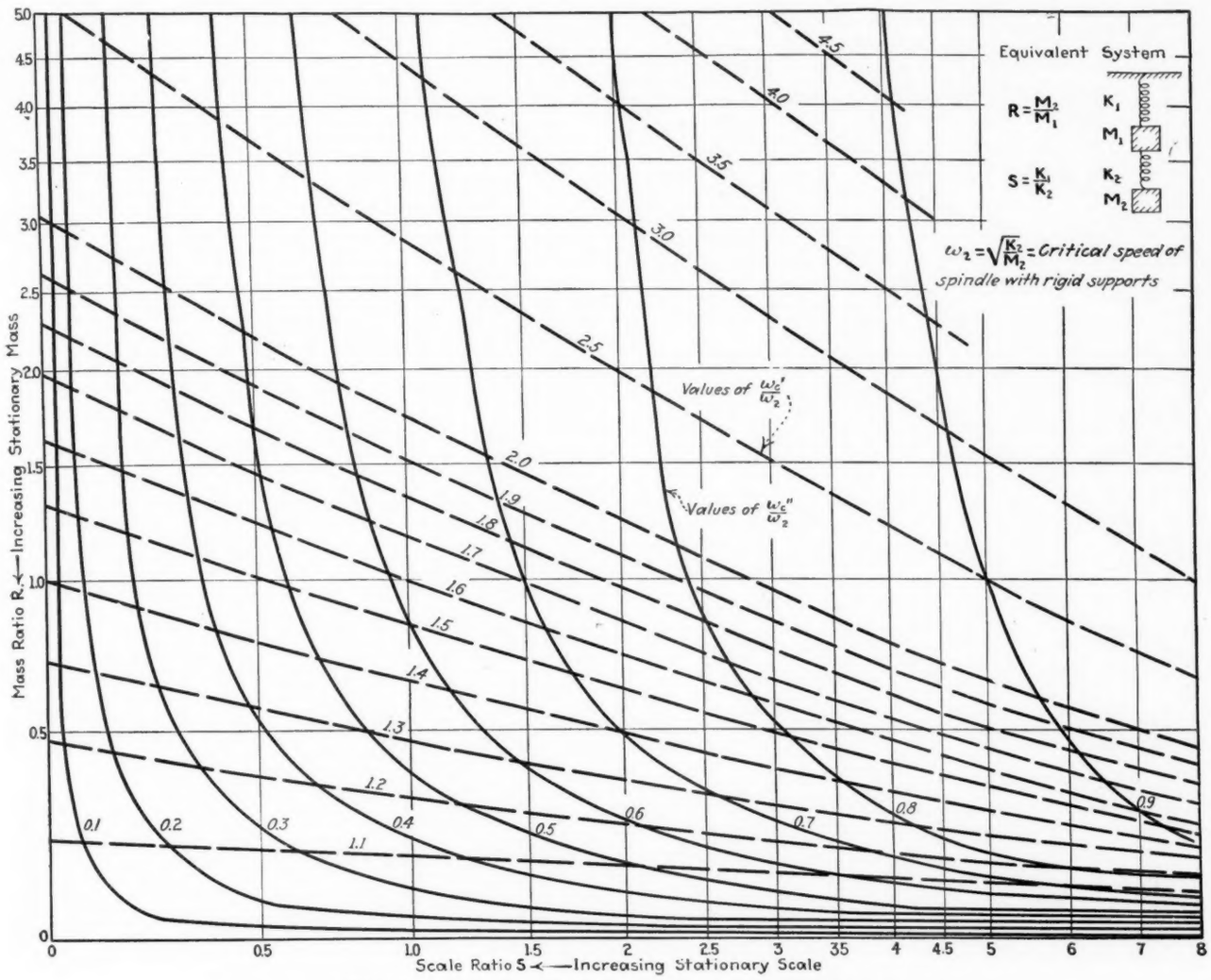


Fig. 4—Chart for finding critical speed coefficients

yet, we have not touched on the lateral and axial modes of vibration, to say nothing of the queer modes in diagonal directions that are occasionally encountered in practice.

Thus it is seen that calculations of the fundamental frequencies of the unit installation are not so satisfactorily accomplished as might have been supposed. At best, very broad assumptions must be made, reducing the structure to some simple system, to facilitate analytical handling. Mathematically exact analysis of the various modes of even simple standard structures may be considered to be practically impossible. A few ex- may change with the loading and also with time, adds an element of uncertainty to the calculations.

Fig. 5 illustrates the reduction of frames to the simplest possible cases. With concentrated masses and weightless members the vertical natural frequencies may be calculated directly from the deflections. The lateral frequency is determined by equating the potential energy in the displaced position to the kinetic energy passing through the neutral position.

To take into account the actual distribution of masses in the structure and the precise deflection curves would entail an extraordinary amount of labor. The foregoing

simple cases represent resonance conditions that usually occur at low speeds.

The most important vibrations are those resulting from an easy mode of vibration which the complex elastic structure adopts for itself at a normal speed. Fig. 6 shows such types of vibration. There are almost innumerable modes which the structure may adopt, within a certain range of speed. As the speed is varied, the modes of vibration gradually pass through a transition from one type to another. Some of these modes require less energy to sustain their characteristic vibration than others, and therefore allow greater displacements to be built up.

Everyone is familiar with the characteristics of vibration on bringing a machine up to speed. The vibration waxes and wanes, as these resonant points are passed through. There are usually one or two major resonance peaks of vibration and several minor peaks. If the speed

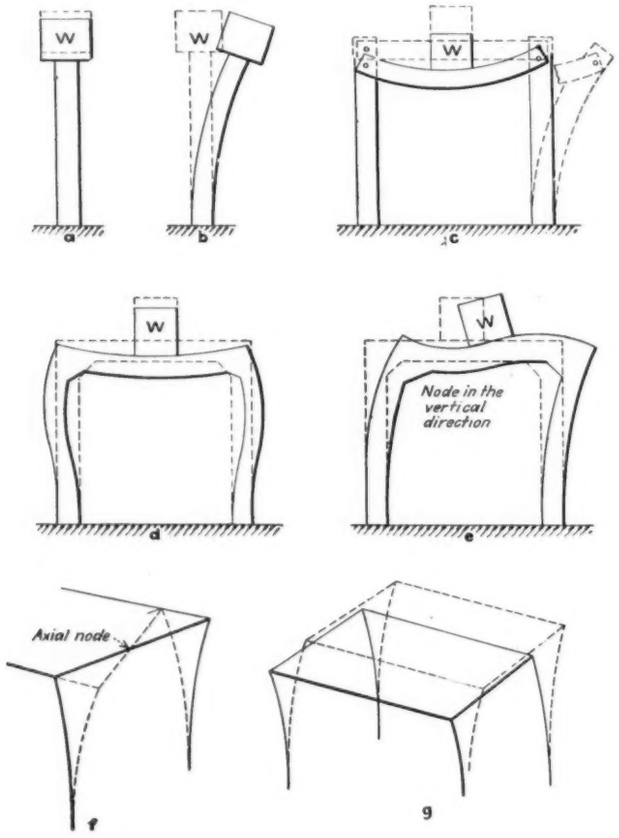


Fig. 5—Foundation frames with concentrated masses and weightless members assumed for calculating natural frequencies

is carried on beyond the normal rate, additional resonances and quiet points may be encountered. Resonance curves of vibration taken in the three major directions are usually totally unlike, as are curves taken at diagonal directions. It may readily be seen that it is next to impossible to predetermine the natural frequencies of all these complex modes of vibration.

On passing through various speeds, the nodes of vibration throughout the structure shift from point to point. As these nodes and anti-nodes traverse a given observation point, the vibration amplitudes rise and fall, giving rise to the characteristic resonance curve. As has been noted, these nodal points may shift while at a constant speed owing to some change in the elastic system.

The phase relation between the unbalanced forces at the rotor bearings may influence the mode of vibration. A purely static unbalance, for instance, would tend to

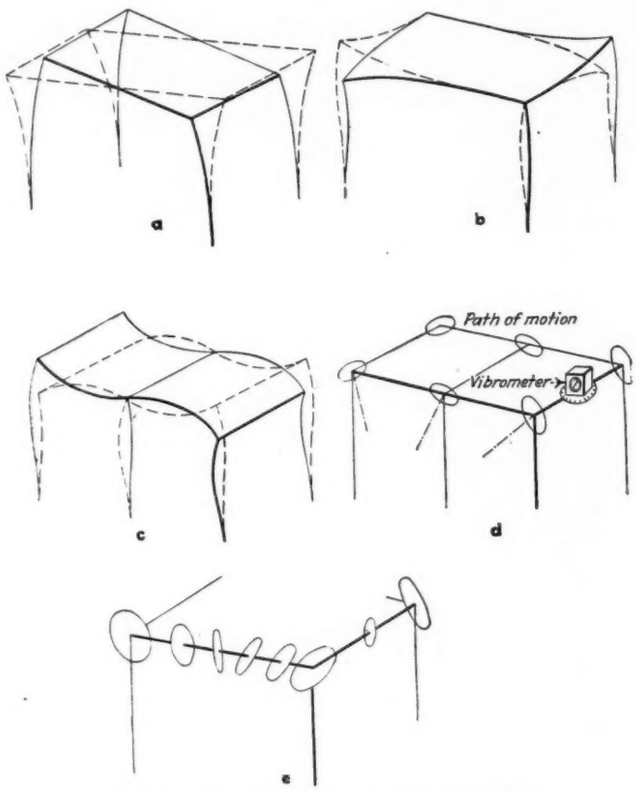


Fig. 6—Types of foundation vibration

vibrate a simple structure in the mode shown in Fig. 5 *g*, while a dynamic unbalance, with its action at the bearings equal and opposite in direction, would be expected to produce a motion as shown in Fig. 6 *a*.

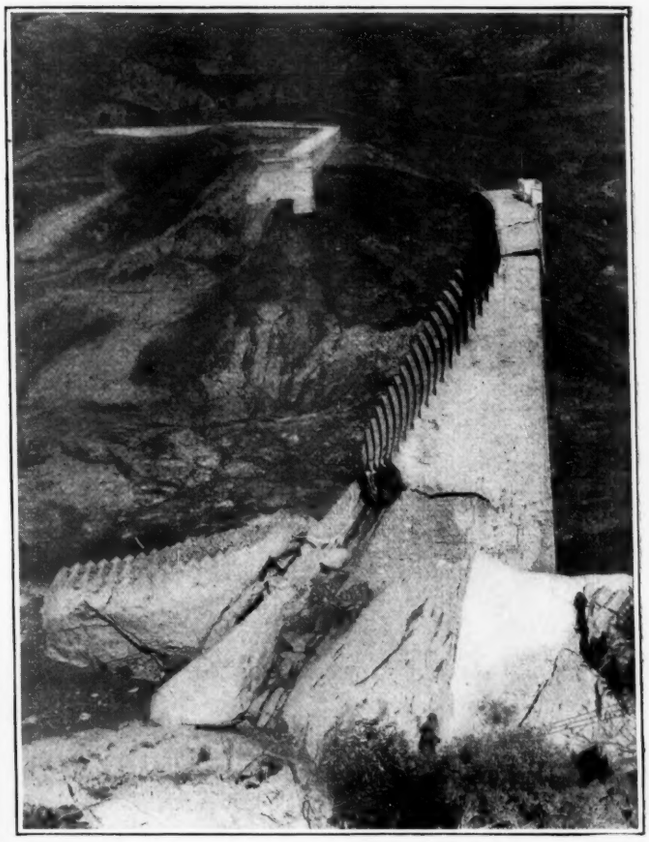
All disturbances to the structure must be transmitted through the bearings. The forces at one bearing affect the motion at another bearing, either augmenting, changing the phase, or neutralizing; depending on the phase difference between the forces at the bearings and to some extent on the speed of propagation of the forces through the structure. This interaction of forces between the bearings presents a grave complication in the efforts toward exact balancing. It has been observed that changes in the location of unbalance may occasionally change the mode of vibration, to the extent of shifting the nodal points. The degree of change and the resulting amplitudes for any phase relation of forces depend on the elastic characteristics of the structure.

The difficulties that render exact predetermination of the natural frequencies of these complex modes almost impossible are, therefore, apparent. In the present state of the art avoiding resonances is largely a matter of chance.

The next article on the vibration of turbine-generator foundations will deal with the field correction of resonant vibration.

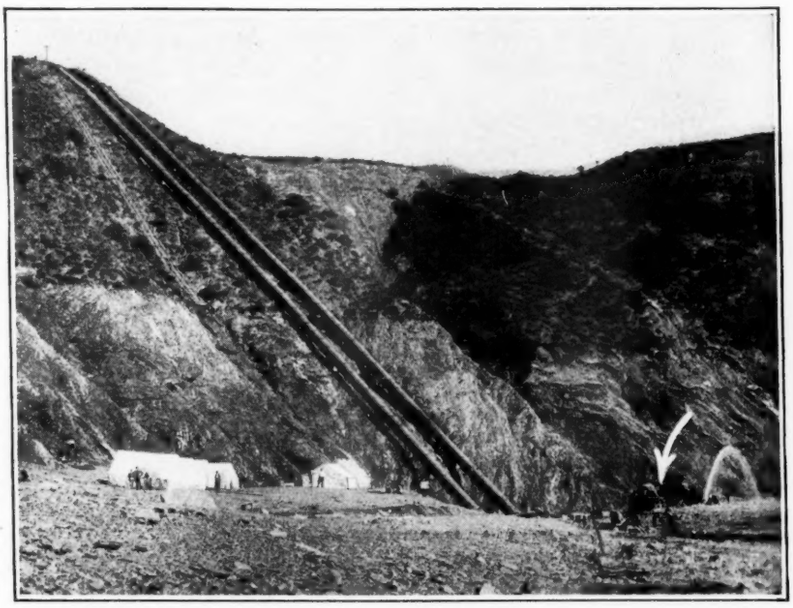
In the Wake of the California Deluge

Views of destruction caused by failure of the St. Francis dam on March 12



Above—Center portion of dam that remains. The break released 38,000 acre-feet of water in a torrent a hundred feet deep. Over two hundred bodies have been recovered and a like number reported missing

Above — This section was carried down stream half a mile



Right — The power house was completely swept away and the penstocks and generators remain

HEATING *and* VENTILATING

University of Iowa Builds Central Heating and Power Plant

A combined steam and water power station furnishes heat and power to the University of Iowa and replaces four existing plants. For heating one group of buildings exhaust steam from the auxiliaries is supplemented by bleeder steam from the main turbines, and for a second group steam is distributed at high pressure.

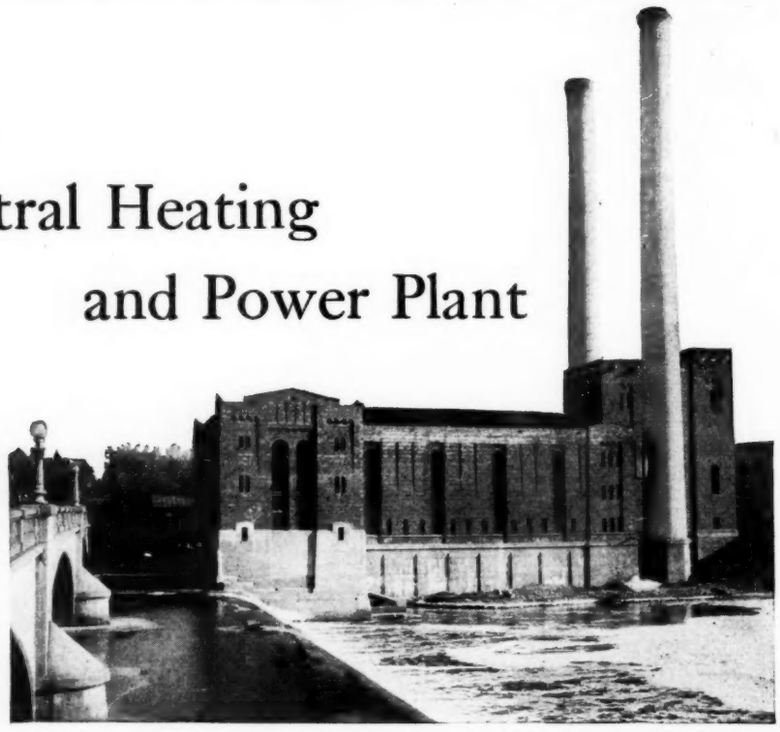


Fig. 1—New central power and heating plant for University of Iowa

By B. P. Fleming
Department of Mechanical Engineering and Consulting Engineer

THE steady increase in attendance at practically all our institutions for higher education in this country is not only accompanied by serious problems in mass instruction, control and administration, but there are equally serious problems in securing adequate classroom, laboratory, library and dormitory facilities, and the services and conveniences that such modern institutions must have. Water, both hot and cold, gas, compressed air, high- and low-pressure steam, distilled water, liquid air, artificial ice and refrigeration—all in addition to electricity, the telephone and radio—are now service requirements; and where such institutions include hospitals, the electric, steam and water services, particularly, must be of a high degree of reliability.

In preparing plans for the creation of a large group of medical buildings at the State University of Iowa, the problem of providing the necessary additional heating, lighting and power facilities was given consideration. The writer was engaged to study the problem and report not only upon the requirements of the proposed medical group of buildings, but upon a comprehensive system of heat and power development for the entire institution, designed to permit expansion as demands increased.

Topography of the campus as well as the existing facilities naturally affected the problem. The chief topographic feature is the Iowa River, a stream about 350 ft. wide, subject to flashy floods of variable volume, which flows through the campus almost directly southward. The university buildings chiefly occupy the bluffs about a quarter of a mile back on either side, while the athletic field and open campus are in the quarter-mile flood plain between, making a total width of built-up area of about three-quarters of a mile. At the south side of the campus, there is a low-head power dam across the river, the hydro-electric plant being at the east end of the dam.

Heretofore, the University has been served by four heating plants, one of which was also a power plant, with a partial system of distribution tunnels. The necessity for a new plant was forced by the removal of the college of medicine and the general hospital to new buildings on the west campus. The new plan calls for a central power and heating station situated at the east end of the university dam, and about on a median line of the campus although at the south edge. The river furnishes abundant water for condensation, and coal may be received by rail.

From this central plant distribution tunnels reach to the various parts of the campus on both sides of the river, the latter being crossed by utilizing the existing power dam as the upstream cofferdam for a tunnel which was built against the downstream face of the dam. Thus

HEATING *and* VENTILATING

the original dam, which was beginning to show signs of deterioration, was strengthened and repaired, and a tunnel secured that now provides a safe and dry conduit for steam mains under the river. A cross-section of this tunnel is shown in Fig. 2.

Coal- and ash-handling facilities comprise two elevated reinforced concrete coal bins, each of about 250 tons capacity and an ash bin of about 50 tons storage capacity.

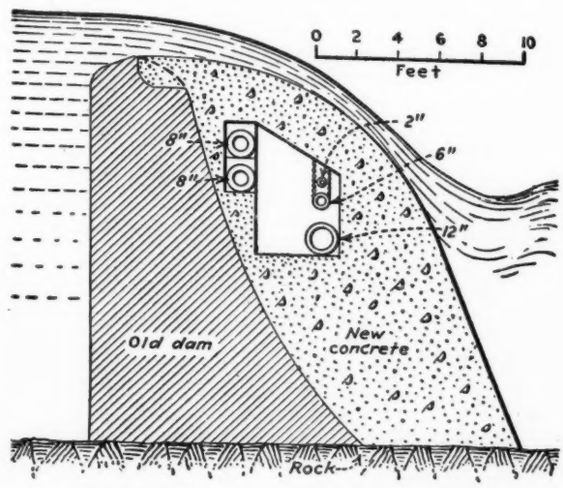


Fig. 2—Pipe tunnel through power dam

The coal bins are not for storage primarily, but provide a bunker from which coal may be distributed by gravity to the boiler furnaces. The coal-handling equipment comprises a track hopper 14x20 ft. in area, from which an apron conveyor takes the coal and discharges it to a pivoted-bucket conveyor delivering to the overhead bins. From the bottom of the bins it is discharged through gates into a weigh larry and thence conveyed to the stokers.

Ashes are stored in brick-lined hoppers suspended beneath the boilers. Gates at the bottoms of these hoppers discharge into a small man-propelled dump car from which the ashes are dumped into a skip hoist with push-button control. A track scale enables the ashes to be weighed if desired.

At present the boiler equipment consists of four vertical bent-tube boilers, each having 6,120 sq.ft. of heating surface and operating at 175 lb. gage pressure. They are equipped with convection-type superheaters for 100-deg. superheat and with soot blowers. Boiler feed lines are in duplicate, with one line under manual control and the other with automatic feed-water regulators. The boilers, served by natural-draft chain grates 11 ft. wide by 13 ft. long, are provided with concave-convex type arches. With a draft of 0.35 in. over the grates and using Iowa coal, 150 per cent of boiler rating is guaranteed. The two concrete chimneys are 9 ft. 6 in. inside diameter at the top and 210 ft. high above the boiler-room floor.

Stoker drive is effected by individual motors belted to a lineshaft beneath the boiler-room floor. Jaw clutches between the different sections of lineshaft permit the drive to be sectionalized, or in emergency, by throwing in the clutches, all stokers may be driven by a steam-engine auxiliary.

In the design, simplicity and reliability in combustion and boiler-room equipment were the principal considerations. Inasmuch as the main purpose of the plant is to furnish steam for heating, high ratings and extreme responsiveness to peak-load conditions are not in the least important and the higher anticipated maintenance charges on equipment for reaching high ratings were found not to be profitable. Pulverized fuel was considered, but the higher cost of equipment led to a decision against an installation of this type, although the arrangement of the boiler room permits the use of this equipment with little or no change in the structural design in the event that the use of pulverized fuel may become desirable.

Boiler feed water will consist of 85 per cent, or more, of return condensate. For the makeup water a hot-process water softener is provided, which includes heaters for both condensate and raw water, and a surge tank for condensate, from which a suction header leads to three boiler-feed pumps. Two of the latter are steam-turbine driven and one is motor driven. This combination will permit the use in the winter time of the

Fig. 3—The first unit of four boilers now in service

turbine-driven pumps, exhausting into a 20-lb. pressure steam line for general heating, into which also the main turbines will be bled.

The main high-pressure steam header is connected to the tunnel lines through pressure reducing valves and bypasses, so that, if desired, the tunnel distribution may be at less than plant pressure. A large, low-pressure 20-lb. line, not yet installed, eventually will convey bleeder steam from the main turbines and exhaust steam from the turbine-driven auxiliaries to the low-pressure heating system on the east side campus. On the west

HEATING *and* VENTILATING

side campus distribution of steam at high pressure only is planned, the pressure being reduced at the buildings.

Return water from the heating systems on both sides of the river flows by gravity to tanks in a low-level pumproom. To aid in returning the condensate, rotary vacuum pumps, provided with automatic control, are installed. From the tanks the condensate is pumped by float-controlled centrifugal pumps to the heater on top of the water softener. These tanks also receive all trap condensate and the returns from the plant heating system. In the low-level pumproom are also a house water supply pump and three pumps for the general water supply of the institution. They are of centrifugal type, one being motor driven and two driven by turbines that exhaust into the low-pressure main for heating service in east campus buildings.

Beneath the boiler room is a reservoir for water service for the institution, with capacity of about one-quarter million gallons. The rear end of the west row of boilers is supported by the roof of this reservoir, and its west wall is the west foundation wall of the boiler room.

Electrical generating capacity consists of two 1,250-kva. 3,600-r.p.m. steam turbine-generators of the bleeder type, with direct-connected exciters. The current is two-phase 2,400-volt 60-cycle. Turbine foundations are independent of the building proper, and have no attachment to the floor except through gratings.

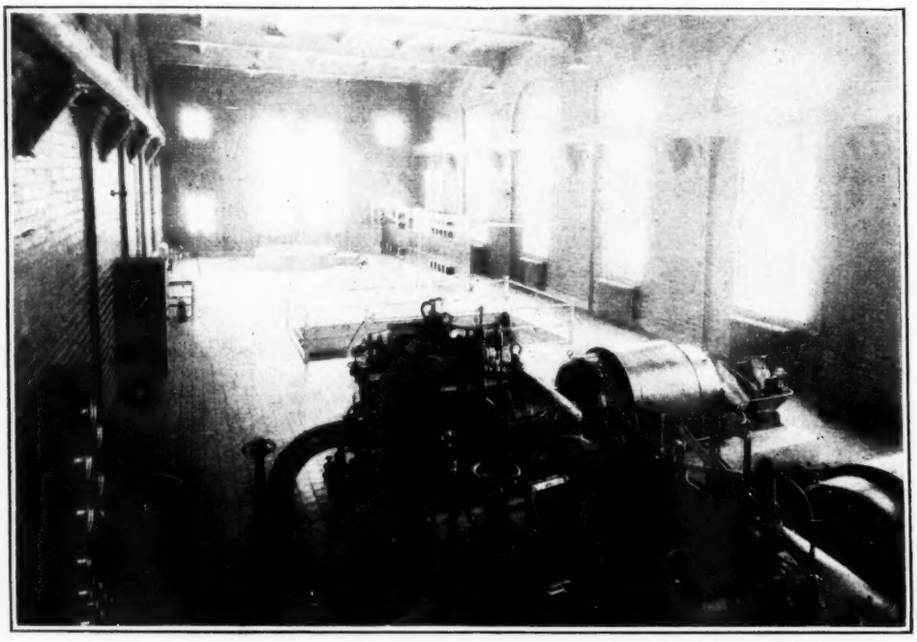


Fig. 4—Two 1,000-kw. bleeder turbine units, with future location of water-wheel generator indicated by circular foundation in background

Condensing equipment for the main steam turbines consists of two 1,000-sq.ft. surface condensers with circulating water and hotwell pumps connected directly to and supporting one end of the condenser. Circulating water is taken from the river by a 24-in. cast iron pipe whose valved inlet is behind the hydraulic-plant trash rack as well as a special rack for this inlet only. Advantage is taken of the nine-foot drop over the dam in normal water conditions to aid the inflow of circulating water by a siphon effect obtained by having the outlet of discharge pipe from the condenser water box below the level of the water on the downstream side of the dam. During normal river conditions there is little load on the circulating pump motors, but in flood conditions the pumps must overcome the frictional resistance in the circulating-water system.

The condensers are purposely small, since during the heating season, under full bleeding conditions, only 2,100 lb. of steam per hour will have to be condensed. During the summer months the lessened vacuum possible with a small condenser will not so materially affect the operating economy as to offset the saving in first cost. Air-removal equipment consists of steam-jet ejectors with intermediate and after condensers. These ejectors are cross-connected, so that either or both may operate on either turbine. Various combinations are made possible by the cooling-water connections to the ejector condenser, so that either main turbine condensate or raw water may be used for cooling purposes as the heat balance may necessitate.

Hydraulic-turbine equipment comprises a 156-kva. umbrella-type generator and vertical waterwheel that has been operating for about fifteen years. The vertical shaft of this unit will be extended and the generator placed on the main turbine-room floor when funds become available. Also, it is planned to add another hydraulic turbine of about 300 kva. capacity, so that when complete, the turbine room will comprise two hydraulic-turbine units and two or three steam units.

For air-lift pumping from deep wells for general university water supply there are two motor-driven compressors each of 350 cu.ft. per min. capacity.

In the expectation that within two years all heating and power load of the institution would be concentrated in the central plant and the other existing plants finally closed down, an appropriation was obtained from the last Legislature which will enable a second boiler-room unit of four boilers to be built and such additional boiler capacity installed as may be needed for the present heating requirements of the entire institution. A second concrete chimney already has been built and work started on the second boiler-room unit.

REFRIGERATION
Equipment and Operation

Making a Ton of Ice
With 21 Kilowatt-Hours

IT IS usual to hear engineers claiming with some satisfaction that their refrigerating plant was turning out a ton of ice at an expenditure of 40 or 45 kw.-hr. Under certain conditions of cooling-water temperature and pressure such power consumption is not to be unduly criticized, but the Pacific Fruit Express Company's Ogden, Utah, plant produces ice at a power rate of 21 kw.-hr. per ton during the winter, and even during the rush season the rate does not exceed 42 kw.-hr.

To those who freeze ice in 35 to 40 hours, it may seem impossible to produce 427 tons in 3,062 cans in 24 hours, making the freezing time slightly over 26 hours. Nevertheless, the Ogden plant records show this to be a fact. In addition no agitation is done, although the ice is clear, with a slight feather in the center and a white mass about the size of one's fist close to the bottom. This ice compares favorably with ice made with air agitation, and it could be sold for household purposes without adverse criticism as to its appearance.

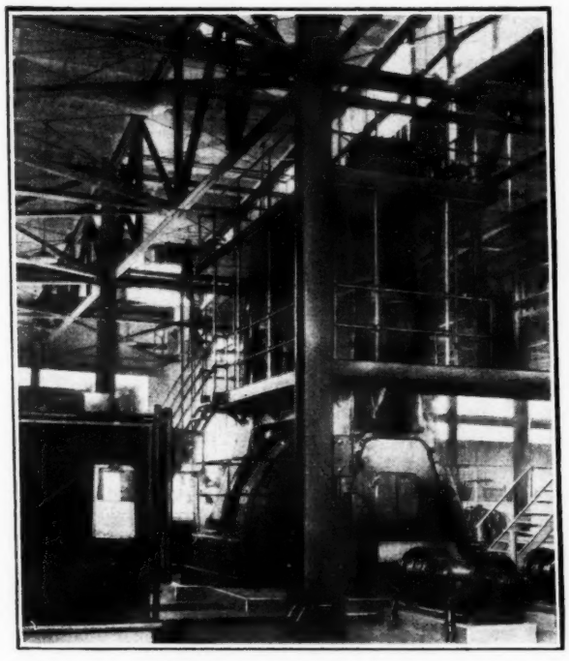


Fig. 1—The 250-ton York twin-cylinder compressor

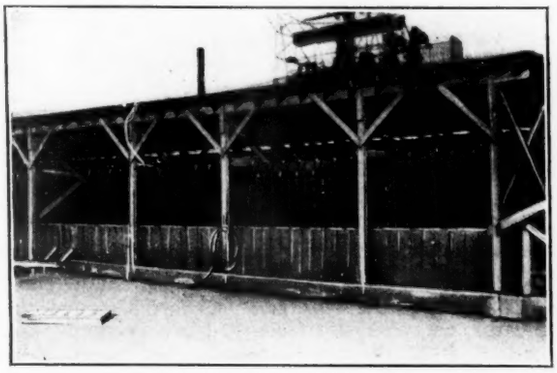


Fig. 2—The condensers are placed outside

The plant contains three compressors. One of these, Fig. 1, is rated at 250 tons and is direct-connected to a 650-hp. 164-r.p.m. synchronous motor; a second is a 150-ton vertical machine direct-connected to a 550-hp. 150-r.p.m. synchronous motor, while the third is a small 9x9 vertical compressor connected through a T. B. Woods idler belt drive to a 50-hp. 900-r.p.m. squirrel-cage motor; this machine is used for pumping out purposes. The first two are York compressors and the small unit is a Frick.

The compressors discharge into an overhead main which carries the hot gas to the condensers placed outside the building. The condensers, Fig. 2, are of the atmospheric counter-current bleeder type and consist of 52 stands of 14 pipes each. The bleeder lines are run into a liquid header leading to the three 26-in. by 10-ft. receivers.

All the pipe lines are welded at the joints, save where flanged valves are inserted. Each of the three receivers has a purge tank placed immediately above the condensers, and the tank contents are cooled before the purge valve is opened by water flowing from a perforated pipe placed above the tank. The condensers and receivers are placed under roofs which cut off the direct rays of the sun while leaving the condensers open to air circulation from all sides.

Cooling water is drawn from the river by one of two motor-driven horizontal centrifugal pumps, located in a pumphouse at the river's edge. Each pump suction has a foot valve to prevent loss of suction. However, lines from the city water mains are led to the pump casings, so that even if the foot valves leak the pump can be primed. This water discharges into galvanized iron notched troughs placed over each condenser stand. After passing down over the coils, the water drops into concrete sumps and is led back to the river. This water is heavy with magnesia, and when its temperature is

REFRIGERATION *Equipment and Operation*

allowed to rise high, considerable hard scale forms on the coils and must be chiseled off.

In September the average temperature and pressures in degrees Fahrenheit and pounds per square inch absolute were:

Water temperature on condenser, 61 deg. F.
Water temperature off condensers, 75 deg. F.
Condenser ammonia pressure, 158 lb. abs.
Condenser ammonia temperature, 83 deg. F.
Evaporating pressure, 26 lb. abs.

It was with these values that 429 tons was made per day during September, 1927.

In winter the cooling-water temperature is much lower and the reduced ice output permits a higher back pressure to be carried. During the coldest months it is necessary to recirculate part of the condenser water in order to prevent the trough and coils from becoming iced. On Dec. 5, 1927, the various gages and thermometers gave the following values:

Cooling water on condenser, 37 deg. F.
Cooling water off condenser, 43 deg. F.
Condenser ammonia pressure, 83 lb. abs.
Evaporating coil pressure, 33 lb.
Discharge gas temperature, 118 deg. F.
Condenser ammonia temperature, 44 deg. F.
Evaporating coil temperature, 18 deg. F.
Brine temperature, 23 deg. F.

These values enable a ton of ice to be manufactured for approximately 25 kilowatt-hours.

Every piece of apparatus has been installed with the single aim of reducing power costs. For this reason a water-cooled ammonia precooler was incorporated. This consists of five sections of a Vogt multi-pass cooler. The ammonia coming from the condenser flows through the inner tubes of each of the sections, these being connected in series, while water passes through the sheets. This water is then used to cool the compressor cylinder jackets, after which it is passed to the can dump tanks to be used to loosen the ice from the cans.

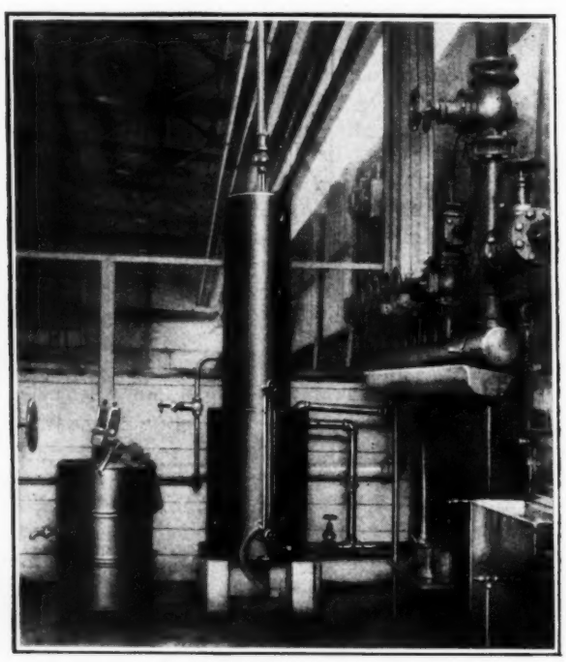


Fig. 3—Oil apparatus to purify the ammonia

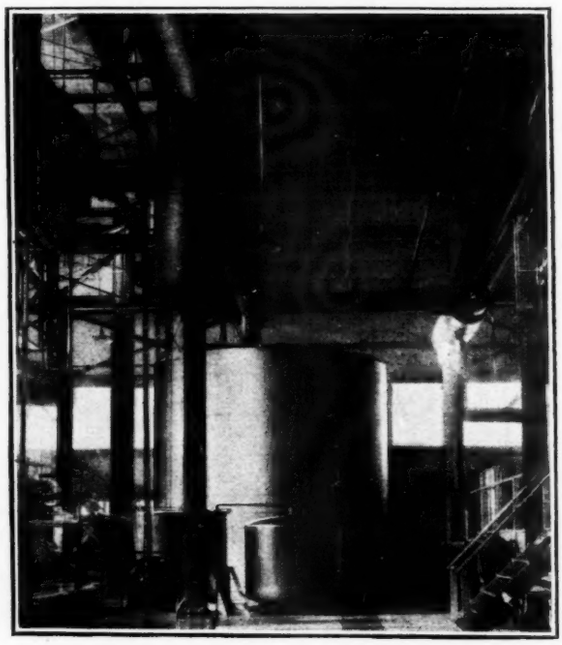


Fig. 4—Water is treated in a Best siphon

In summer this water cooling of the ammonia reduces its temperature from about 7 to 8 deg. F. before the liquid goes to the ammonia precooler. After being reduced in temperature the liquid flows along the pump into the manifold shown at the right in Fig. 3, out of which it passes either to the three suction precoolers of the three tanks or to the two sets of coils located in the ice storage rooms.

In winter and at such other times as desired, the ammonia flows directly to the manifold. The ammonia liquid is further precooled by the suction gas, in a standard Vilter precooler. This arrangement is shown in Fig. 5. At the Ogden plant two of the precoolers are arranged to receive the suction gas from the ice-storage room coils. The storage coil suction enters the precooler at one end, and if any liquid is carried over it falls downward into the tank suction line and is not carried through to the compressor suction line. An oil trap is placed below the precooler so that oil and scale will settle out of the liquid line.

Occasionally the contents of the trap are pulled over to the purifier shown in Fig. 3. This consists of a steel tank surrounded by a second open tank containing water. The water reduces the temperature of the mixture, settling out the oil, after which the ammonia is drawn off to the suction line of the compressors. This permits a large amount of cylinder lubrication to be used without reducing the capacity of the coils. The oil is put through a centrifugal, but is not used in the compressor again.

REFRIGERATION *Equipment and Operation*

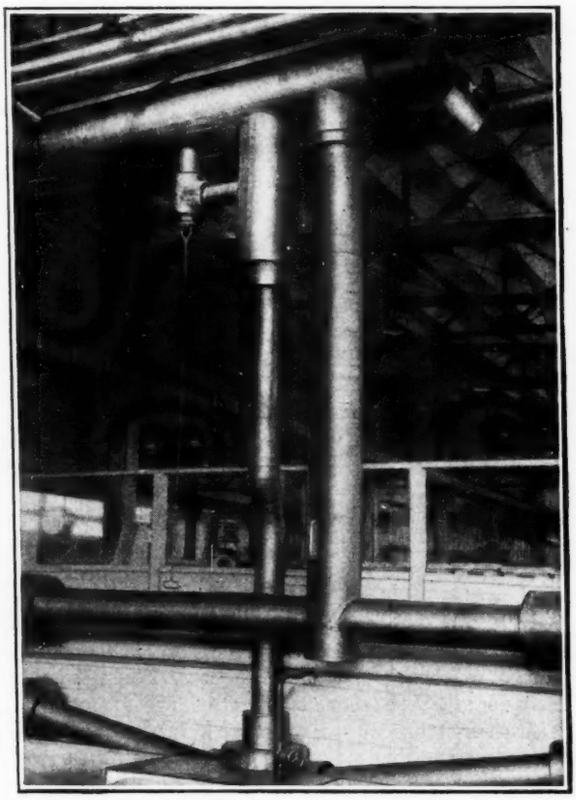


Fig. 5—Ammonia connections at the tank

being applied to the bearings of the long conveyor chains on the car-icing platforms.

As has been stated, no air agitation of the ice cans is used. One of the tanks is equipped with a rotary blower, air lines and drop pipes, but it has been found that by attention to the purification of the can water it is not necessary to use air agitation to obtain clear ice. This, of course, eliminates the power needed to operate the blower or air compressor, and is one of the items responsible for the low power costs.

The can water is taken from the city mains and is treated in a Best water-treatment apparatus. The cores are sucked by a water jet siphon. This consists of a small tank containing a supply of water which is drawn in a small motor-driven centrifugal pump and discharged back into the tank through a jet. The throat of the nozzle has a connection to the suck-out line. This arrangement insures a suction on the suck-out line at all times.

Three cans are pulled at once and in the busy season six can pullers are used per shift, while the machinery is handled by one engineer and one oiler per shift. The number of men in the storage room varies with the output, as does also the number working on the car-loading platform. A few men are kept all the year, but most of the platform men are of the so-called "floater" type, who work at an icing station a few weeks and then drift to the harvest fields or railroad-grading outfits. The great difficulty in operating one of these railroad icing stations is that of obtaining icers at not unduly high wages.

Two of the compressors are among the largest built, and during seasons of low capacity it is necessary to run but one machine and but one cylinder of this. One of the connecting rods is unshipped and the piston blocked up, so that the motor drives the other side only. This, of course, results in a reduced motor efficiency, but the over-all efficiency is greater than it would be if both sides were used, with the resulting low suction pressure.

The compressor bearings are lubricated by a Nugent oiling system with gravity oil lines. The oil is pumped by a small rotary pump to an overhead tank and, after dropping into the crankcase sump, is picked up by a second rotary pump and delivered to a gravity filter. Both pumps are driven by a single $\frac{1}{6}$-hp. motor, and to insure service three such units were installed, although only one set is kept in operation.

Cylinder Boring

CYLINDER boring is the most important job we have to contend with in compressors. Generally, it is a contract matter and someone in the employ of the plant owner or in whom he has confidence, must see to it that the contractor is competent and equipped with proper tools. The bar should be large enough so that there will be a minimum of deflection, properly secured in bearings and securely fastened in position.

To align a bar properly it is necessary to run a line through the cylinder and place it in such a position that when the cylinder is bored to the line, the piston will run true at all points of the stroke. While generally, such a line, when set, will be central in the counterbore or neck bushing in the stuffing box, this is not always the case. Sometimes, machines are found where the above points were off center to a true alignment. In such a case it is necessary to make marks on the cylinder faces at equal distances from the line, to use to centralize the bar when it is set up.

I cannot emphasize this point too strongly, since the operation of the rod and piston depends on the set-up of the bar. The line should strike the center line of the crankshaft and strike central in the counterbore or gasket groove at the head end. Guides should be checked against the line, and if it is found that the rod will move out of alignment more than 0.015 in., the guides should be bored with the cylinder. Piston rings should be made of a close-grained gray cast iron finished after cutting and should fit freely in the grooves. Clearance between the piston and cylinder should be 0.001 in. per inch of cylinder diameter.—*W. D. Whaley,* in a paper presented before the N.A.P.R.E.

A CORRECTION—In the report of the Chicago Power Show which appeared in the February 28 issue, the term "Cement Gun" was inadvertently used in describing the exhibit of the S. Obermayer Company. The name "cement gun" is the registered trade mark of the Cement Gun Company, Inc., Allentown, Pa. and refers specifically to the product of this company.

ELECTRICAL *Operation and Maintenance*

When and When *Not to* Make

High-Potential Tests

N. L. REA
Construction Engineer General Electric Company

discusses this question and gives an opinion based on many years of experience with a large number of electrical-equipment installations

WHEN should high-potential tests be made and when not, is the question that comes up again and again. There is such a great difference of opinion among designing and operating engineers that the ordinary layman has good excuse for being confused. The whole subject should first be divided into two sections and each considered by itself. These divisions are new machines and machines that have been in service.

These sections are to my mind entirely separate and distinct. An anchor chain or gun is given a "proof test" to develop hidden flaws, but no one would dream of repeating these "proof tests" frequently. Years ago a chief engineer asked me: "What do you think of high-potential tests?" I replied: "The contract calls for twice normal voltage plus 1,000." Said he: "I know the contract requirements as well as you do; I asked for your opinion." I said: "I'll answer Yankee fashion. You have two fine 150-ton cranes; did you ever lift 300 tons to see if you could break one of them?"

It is my belief that every time you apply an excessive strain to anything, you take away some of its strength and useful life. Just how much harm is done is a question, but every test must weaken the insulation to some extent.

A new machine should have a high-potential test after the coils are installed in the armature, to locate any faults or injuries developed during the manufacture and installation of the windings.

The amount of the test should be determined by the voltage of the machines, the insulation used and the other design factors. If there is a question as to the proper methods and voltage to be used, the company manufacturing the machine should be consulted. They should know better than anyone else the correct voltage, length of test, method of applying and the proper safeguards to prevent unnecessary strain or injury.

Too much care cannot be used to see that all tests are properly made. It is all too easy to weaken or even destroy first-class insulation by too much and too high potential testing. Then, too, one should know something about the wave shape of the high-potential equipment. The equipment may have a sharp high-peaked wave, produced by a combination of the original power wave plus distortion caused by low power factor and possible overloading. Many engineers and operating men do not appreciate the large amount of kilovolt-ampere capacity necessary for making a high-potential test on a large armature, which may be as much as 350 or even higher for large machines.

I have known of tests made on a large armature with a 200-watt instrument transformer arranged with a voltmeter across the low side and the readings of this meter multiplied by the nameplate ratio to determine the test voltage on the high side. This method is fine for the peace of mind of the operating force. "Sure the generator is all right. Didn't it stand up fine when high potted?" but a seventh son of a seventh son could tell as much about the actual condition of the installation.

You must have sufficient capacity and some safe and sure method of raising the voltage uniformly to the proper value, holding it steady at the testing voltage during the test, reducing it evenly and then opening the circuit. The voltage control can best be handled by having a separate generator for furnishing the power with plenty of resistance in the field circuit, a diagram for which is shown in Fig. 1.

If this arrangement is not feasible, an induction regulator, such as used in Fig. 2, or some other method may be used. A water rheostat has been used for regulating the voltage input, but this is at best a dangerous arrangement and all possible precautions should be taken to prevent sudden application of excessive voltage. The equipment should be so arranged that it is impossible for anyone to come in contact with high voltage.

If it is possible, a small step-down transformer should be arranged across the high side of the testing transformer to read the test voltage direct. The second best arrangement is a voltmeter across the low side of the testing transformer and a sphere gap across the high side. With this method the sphere gap should be set for the proper voltage. A sphere gap should never be used without a high resistance in series. The voltage should be built up until the gap spills over and the meter readings taken. This must be done before the transformer

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is connected to the machine to be tested and it is done to calibrate the outfit. Then the gap should be set 10 per cent higher and the voltage held at the calibrated voltage on the voltmeter. The sphere gap will catch any overrun of voltage, but it should be kept from spilling over if possible, for the arcing may cause swings or higher frequencies and so increase the test voltage. The table gives sphere-gap spark-over setting.

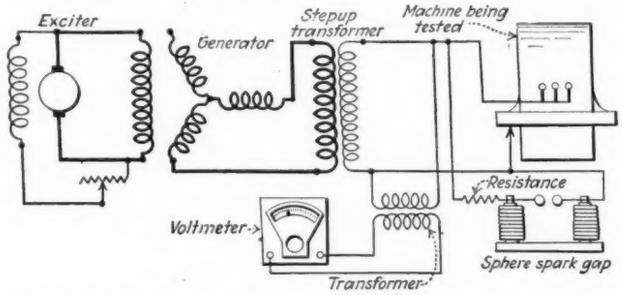

Fig. 1—Diagram for making high-potential test, voltage controlled by generator field rheostat

All the connections of the high-potential testing equipment should be made securely, as a loose joint or break in the circuits may cause arcing, and this arcing may produce overvoltage or high frequency or both and break down the insulation undergoing test.

Condition of Equipment Being Tested

The condition of the apparatus at the time of test is important. New machines should, of course, be dry and the temperature is usually given in the contract. Failing this, the A.I.E.E. rules should govern. Above all, the equipment must be clean. Dust will cause a great deal of static. Little dust particles on the surface of the insulation seem to glow first and, finally, fairly blaze up and disappear as the voltage rises.

When it comes to testing apparatus that has seen service, there are several factors to be considered, including the kind and age of the insulation, its condition and the reason for the tests. The life of varnish and fabric insulation depends largely on the operating temperatures.

I have seen 25-year-old machines that had never carried more than full load in a cool, damp location, where the varnish would "hair" when layers of tape were removed. These coils were as good as when first made. On the other hand, I remember two machines that hardly ever operated at less than twice full-load current. The insulation was as hard and brittle as glass, yet the machines operated several years in this condition.

Mica insulation will stand much higher temperature than the older types and should age less under the same conditions.

Some stations have periods of light load when the machines can be thoroughly overhauled and cleaned for the periods when they are badly needed. A machine that has been cleaned and revarnished would, naturally, stand a higher test than one full of dirt.

Someone has said that annual high-pot tests were a fine thing, because the machines got a thorough cleaning first and the cleaning was the altogether desirable thing.

In general, however, a machine that is clean and dry should stand its rated voltage to ground or possibly 25 per cent more than its rated voltage, but not higher than 25 per cent in any case. Some of the large operating companies use the full-voltage test. This is about 25 per cent above the maximum voltage to ground when operating under normal conditions.

SPHERE-GAP SPARK-OVER VOLTAGES AT 25 DEG. C. AND 760 MM. BAROMETER*

	Sparking Distances in Millimeters			
	62.5-Mm. Spheres		250-Mm. Spheres	
Kilovolts	One sphere Grounded	Both Spheres Insulated	One Sphere Grounded	Both Spheres Insulated
10	4.2	4.2	....	....
20	8.6	8.6	....	....
30	14.1	14.1	14.1	14.1
40	19.2	19.2	19.1	19.1

* A.I.E.E. Standards.

All the phases should be connected together and tested as a unit. When one phase is tested at a time and the other phases grounded, there are dead coils on either side of the live coils. This increases the capacity and charging current of the winding about 20 per cent and gives a corresponding increase in the burning effect of the test, due to corona on the surface of the insulation.

The opinion that insulation resistance gives an indication of the ability of the insulation to stand a high-potential test is quite prevalent. This opinion, however, is not at all warranted. True enough, insulation resistance gives the best indication of the dryness of the insulation, but such readings are relative only. They may vary over a wide range owing to temperature, humidity, the amount of dirt on the windings, the kind of insulation and the amount of moisture in it. Duplicate machines may not have the same insulation resistance owing to combinations of these factors. The insulation resistance of a new machine indicates little more than the condition of the windings with regard to moisture, and the rate of change of the resistance indicates the progress of the drying.

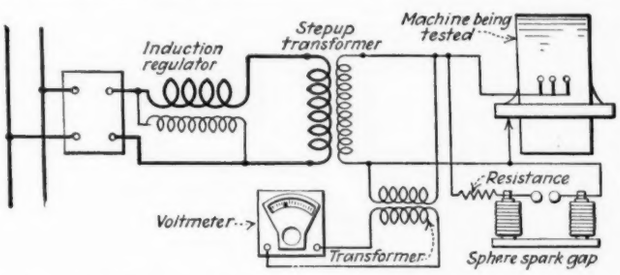

Fig. 2—Diagram for making high-potential test, voltage controlled by induction regulator

The insulation resistance drops quite rapidly as the temperature rises, owing to the change in the specific resistance of the insulation, and reaches a minimum about the time the windings reach a constant temperature, and increases as the drying proceeds. The increase is quite rapid at first and then slower, until it becomes practically constant. A rainy or foggy day following bright clear weather may cause a big drop in the insulation resistance.

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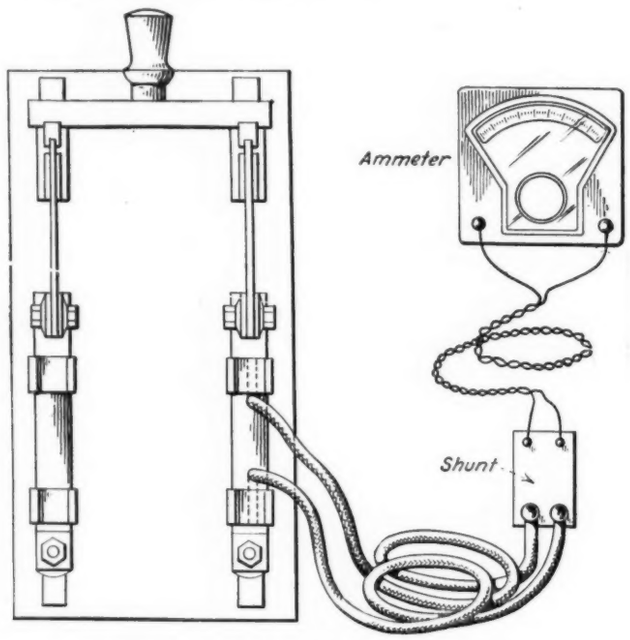
To settle an argument I once took a new coil and cut a notch through the slot armor and insulation to the copper and put this in the armature slot. It showed an infinity reading on a high-range instrument that reads insulation resistance directly. This coil showed an insulation resistance just as good as an undamaged coil, yet it broke down to ground with less than normal voltage.

Making Load Testing an Easy Job

By David Williams

TAKING current readings on electric motors is a highly important duty in the electrical maintenance departments, and to facilitate this work I took a cartridge fuse and drilled two holes in it for the insertion of two conductors. These two conductors were connected to the two terminals of the fuse similar to the way a renewable link is inserted. The other ends of these conductors were then connected to the portable ammeter shunt, as in the figure.

It is quite common practice to loosen a lug or splice somewhere in the motor circuit and connect in the meter leads. This requires time, the connections are frequently poorly made, and the temporary connections for the reading have caused dangerous grounds. In some departments the machines are so busy that the delay to take a reading is complained about. With the little device shown in the figure, the meter is connected in the circuit quickly and has added considerable toward raising the efficiency of the maintenance department as well as that of the production department.



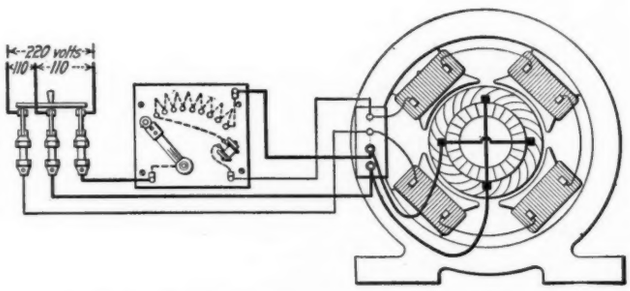
Method of using test fuse and ammeter

It takes only a short time to make a test fuse case for each size and type fuse used in a plant and they pay for themselves the first time they are used.

How the Motor's Speed Was Reduced

By M. E. Wagner

SOME time ago I had to apply a direct-current motor to a machine through a belt drive. The machine operated at a very low speed and the motor had a speed of 1,500 r.p.m. The pulley on the machine was a combination pulley and adjustable-speed friction drive, so it could not be changed. Therefore any changes made in the pulley size had to be made on the motor. When the motor was belted to the machine, with the smallest pulley that it was possible to use on the motor, the machine operated at a speed more than double that desired.



Motor's armature connected to 110 volts and the field coils to 220 volts

The problem was to reduce the speed of the motor or obtain another motor which would operate about 600 r.p.m. On account of the cost, the latter solution was not satisfactory. The motor was designed for 220 volts, and it was decided to reduce the voltage on the armature to one-half, or to 110. The neutral of the three-wire circuit was available in the distribution box, and the conduit running to the motor's switch was large enough to contain three wires of the desired size. The two wires were pulled out of the conduit and pulled in again with an additional wire.

A three-pole switch was installed and connected with the 110- and 220-volt power supply. Then the motor was connected as in the figure. As can be seen, the armature is connected to 110 volts and the field coils to 220 volts. This resulted in reducing the speed to about 750 r.p.m., at which speed the machine could be operated.

It was desired to have the speed somewhat lower than 750 r.p.m. if this could be accomplished. The polepieces, being bolted to the frame, allowed placing soft iron shims back of them to reduce the air gap between the armature and the pole faces. This change resulted in a further speed reduction of about 100 r.p.m. and gave the desired speed for the driven machine.

If the load had been constant on the motor, a resistance could have been connected in series with the armature to make part of the speed reduction, but in this case the load was very intermittent. Under light-load conditions the motor would tend to increase to nearly normal speed and, when the load increased the motor would slow down. Another objection to using a resistance in the armature circuit is the increased cost of power.

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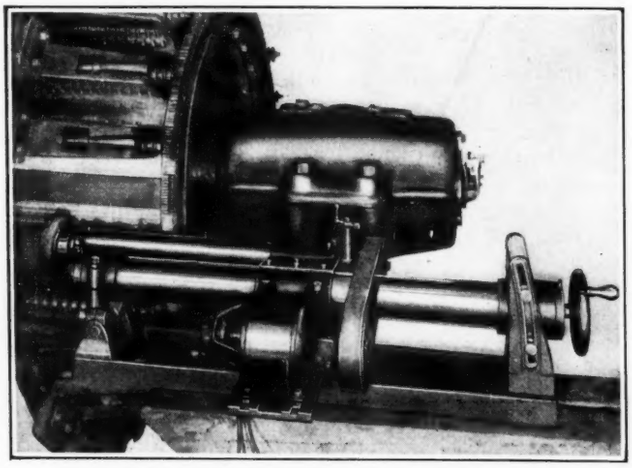
Eliminating Armature End Play Reduces Commutator Wear

By W. E. Warner

END play for direct-current armatures in their bearings was at one time considered a necessity, to allow the armature to center properly in the magnetic field and to prevent the brushes wearing grooves in the commutator. However, with the advent of anti-friction bearings and certain types of speed reducers, the end play of motor armatures is practically eliminated. These motors operate just as satisfactorily as those providing armature end play. The brushes should be staggered in any case so as to distribute the wear on the commutator.



Power driven commutator grinder

A considerable item in direct-current motor maintenance is the turning up of commutators. In a mixed installation of direct-coupled, belt- and chain-driven machines it was found that the motors that gave best commutation and ran longest before it was necessary to dress up the commutators were those on the chain drives with very little end play. On another installation employing over 1,000 motors the least expensive motors to maintain were those with little end play.

With no end play the brushes run in one position, and it is true that they may wear a groove in the commutator. This does not seem to be objectionable and does not affect commutation, as is shown by the results obtained. With end play, if the wear were evenly distributed as in theory, turning up should not be necessary. An examination of commutators with end play will show that these wear in grooves just as do those that have no end play.

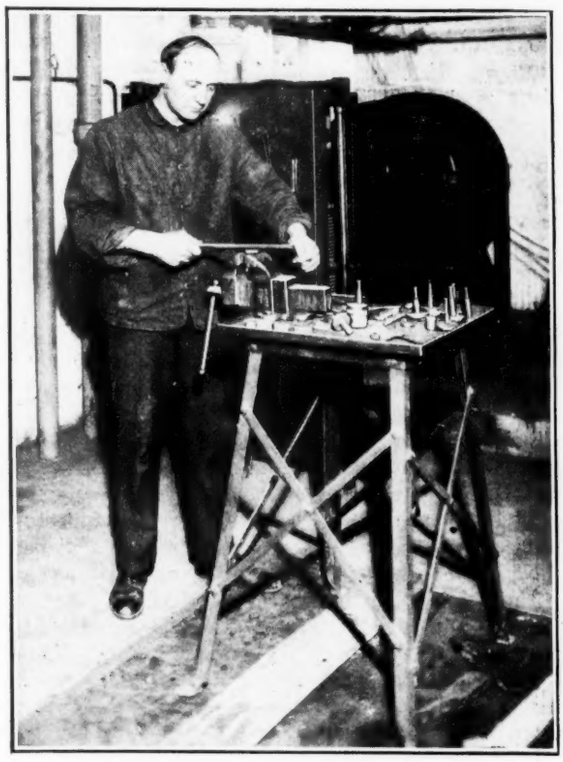
Although truing up with a lathe may be a necessity with a badly grooved commutator, it is better to grind them at intervals when the surface begins to get rough. This practice results in better commutation, and the metal removed from a commutator is generally not so great as when turning up in a lathe, where more metal is sometimes removed than necessary. There are now a number of handstones and commutator grinding devices available. The latter are fixed to the machine and the grinding done without removing the armature, as in the figure. A small grinding attachment is not expensive and can easily be fixed for turning up the commutator. The hand-stones are very convenient for removing minor defects from the commutator and preventing them becoming faults that will require a lathe tool or power driven grinder.

A Workbench Simplifies Elevator Repair Work

By J. H. Fullerton

ELEVATORS, machines and controllers are usually located at the tops of buildings, where the repair shops are in the basements. Therefore, it is not always convenient to take every little repair job to the shop, where it can be most easily done. To overcome this inconvenience, I made a special type of workbench suited to the limited space generally found in the average elevator machine room.

This bench is shown in the figure. The top is about two feet square, made of $\frac{1}{8}$-in. sheet iron. The sheet is notched at the corners and the edge turned up so as to form a rim to prevent tool or repair parts from falling off. On this top a vise is mounted, which is handy when work has to be done on control or other small parts of the elevator equipment. A support for the bench is made from one-inch angle iron braced with flat bars as indicated.



Workbench in elevator penthouse

Combining Power and Process Steam in Pacific Coast's New Pulp Mills

By B. T. McBain*

FOR many years before the war pulp and paper mills the world over made so much money that they did not stop to consider efficiencies in the generation of steam and electric power, in the pumping of water and in other factors relating to the auxiliary equipment. In fact, little attention was paid to anything other than the quality of the pulp and the quantity produced, with the result that inefficient conditions were allowed to creep in and to exist even in the best mills.

The possibilities of combining the lumber and pulp industries, making either one the byproduct of the other, have been overlooked to a great extent, but efforts in this direction are now beginning to bear fruit. Today there are mills on the Pacific Coast operating on pulp and paper from the waste of sawmills, while others are being built to stop the enormous waste in the logging industry and to produce the pulp so badly needed, for in the United States, mostly in the East and in the Middle West, there are 840 paper mills and only a few over 300 pulp mills, while imports of pulp in all grades are in millions of tons annually.

In 1926 American paper mills imported over 1,500,000 tons of all kinds of paper pulp, and American consumers of paper imported nearly 2,000,000 tons of various grades of paper, chiefly newsprint. In addition to those two items American pulp mills imported over 1,500,000 cords of pulpwood for the manufacture of pulp within the paper-making states.

Lumber Output of Oregon and Washington

In 1926 the States of Oregon and Washington, in their 1,600-odd sawmills produced over 12 billion feet of lumber, 13.2 per cent of which was of spruce and hemlock, in addition to the logs of these two species turned out from the logging camps for pulp and paper mill work. During the same year the logging camps and lumber mills of these two states burned up, or allowed in other ways to go to waste, more pulpwood than all the pulp mills on the Pacific Coast used in the manufacture of pulp and more than enough for the manufacture of all the pulp that was imported from foreign countries. This is not a new condition, but one that has applied for many years. With the natural increase in the production of lumber, the waste has increased, while the pulp producing districts of the East and the Middle West are gradually using up all their pulpwood, to the end that within a short time many of the mills must either shut down or secure their pulpwood supply from foreign countries.

Financial interests have been taking note of this condition, and today there are being built in the States of Oregon and Washington quite a few sulphite and sulphate pulp mills, but still in no way a sufficient number to supply the demand and stop the importation of these pulps. At the present time there are mills being built at Hoquiam and Port Townsend, the former to make daily 100 tons of sulphite and the latter for the production of sulphate pulp. There has just been completed a 100-ton mill at Shelton, Wash., for sulphite, and one for a like amount of sulphate at Longview, Wash., is now in operation. A new paper mill of 40 tons daily capacity has been put into operation near Olympia, Wash., at Tumwater, and a 50-ton sulphite mill recently began production at Newberg, Ore. In addition many new paper machines have been installed on the Pacific Coast during the last year.

New Sulphite Mills at Astoria and Aberdeen

Two new sulphite mills are being built from designs prepared by the writer's organization, one at Astoria, Ore., and the other at Aberdeen, Wash. The former will be of 120 tons capacity for the manufacture of unbleached sulphite pulp, and the other of 100 tons capacity of bleached sulphite pulp. In these mills many of the late features in pulp-mill design will be incorporated. One of the plants will be equipped with its own electric power plant, using steam of 450 lb. initial pressure through turbines of the extraction type. The extracted steam at 125 to 150 lb. pressure will be used in connection with a Ruths accumulator for the process work in the pulp mill in the way of cooking, drying and heating. There will be a sufficient amount of steam needed for the process work to produce all the electric power required in the operation of the plant. The cost of the electricity will be the usual operating, maintenance and depreciation charges with the exception of fuel, for practically the same amount of fuel would be necessary in any event, and besides, the fuel will come in the form of hog sawmill waste, which cannot be used in the manufacture of pulp.

These mills will have their own wood preparing plants in the form of regular commercial sawmills, which will take commercial logs, averaging 3 ft. in diameter, and produce in the form of lumber such portions thereof as will make No. 1 and clear grades, the balance of the log being used as pulpwood in addition to the clean slab wood and inside trim.

The drying of the pulp after it has been manufactured and screened will differ from the practice in Eastern mills. After putting the pulp into wet-sheet form, it will be shredded into pieces from 1 to 4 in. diameter and passed through a drying chamber in the same manner that cotton is dried, the air-dried pulp falling out into the hopper of a baling press which will be capable of baling to a density of between 40 and 45 cu.ft. per ton.

Up-to-date methods of handling the material in the finished form will be used. The Aberdeen plant will be equipped with the latest type of bleachers, and bleach-making equipment will be installed for the manufacture of bleach liquor from liquid chlorine. At both plants unusable wood waste from the sawmills in the form of hog fuel will supply not only the power for the operation of the sawmills, but also the steam for the cooking and drying. Throughout the plants technical men will be in charge of all departments.

Both plants are being designed so that paper mills may be added should market conditions warrant, but it is more likely that the additional space reserved will be used for a duplication of the first unit rather than for the manufacture of paper. With the exception of some minor changes and the final detailing, the plans for both mills are practically complete.

*Pulp and paper specialist, Portland, Ore.

Waste-Heat Recovery

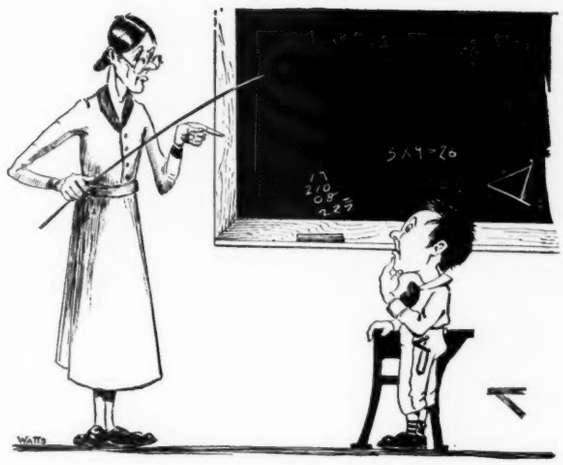
AT THE last meeting of the Institution of Mechanical Engineers, recently held in London, Maj. W. Gregson read a paper that dealt with the main aspects of the recovery of waste heat by steam raising in the steel and carbonization industries.

While the whole of a steel plant is collected in one unit, the ideal of the "self-supporting" works is, he said, readily attainable. That is, by proper waste-heat recovery, together with the full utilization of surplus coke-oven and blast-furnace gas, the works can operate on the coal used in the coke ovens only. Even the producer coal and the resultant gas is replaced by an equivalent gas consisting of mixed blast-furnace gas and coke-oven gas. The result is that the net coal consumption per ton of finished steel can be reduced in certain cases from about 65 cwt. to approximately 32 cwt. Taking a figure of 35 cwt. to allow a margin and to include small outside services, the saving of 30 cwt. at 12s. 6d. ($3.03) per ton means an economy of fuel alone of nearly 19s. ($4.60) per ton of finished steel. On a steel plant making 200,000 tons of steel per annum, a saving of £190,000 ($925,000) on fuel alone constitutes a very big item.

Practice has shown that the normal gas works can meet the whole of its power and process requirements by means of waste-heat steam, and in this instance it must be remembered that comparatively small power units, with consequent low efficiencies, are involved. In the author's opinion the electricity supply and the gas works in every town should be interlinked and under one control, such an arrangement having many advantages. The general scheme would be to use all coke breeze, and any other coke not required for sale, in high-pressure boilers; waste-heat recovery would be employed at medium pressures (to obtain the best quantitative results), and the steam from the two sources would be combined in mixed-pressure turbines, or alternatively a system of high- and medium-pressure turbines, "bleeding" low-pressure process steam. All works services would, of course, be electrified.

The gas works of Great Britain carbonize some 16,000,000 tons of coal per annum. Assuming that this coal uses 14 per cent of its weight of coke for carbonization, the total annual consumption of fuel coke is 2,240,000 tons. With settings properly arranged for waste-heat recovery, four tons of steam per ton of coke would be an average figure to represent both modern vertical-retort practice and modern regenerative horizontal-retort practice. Therefore nearly 9,000,000 tons of steam would be available. Before the advent of waste-heat recovery practice, gas-works steam was generated from coke breeze at, say, 6 tons of steam per ton of breeze. Therefore waste-heat recovery adopted throughout our home works would represent 1,500,000 tons of coke breeze saved for other purposes.

In dealing with both steel plants and carbonizing plants, the subject of waste-heat recovery is, of course, closely interlinked with the complementary subject of the effective utilization of the steam. Each individual works has to be properly reviewed before the best all-round solution can be found. Low-pressure steam from turbine works for process work, steam accumulators to balance supply and demand, and the elimination of small isolated heat engines as prime movers are among a number of salient features in this aspect of the subject.



What Do You Know?

By L. H. Morrison

The answers are on page 612

Ques. 1—If the governor controls the cutoffs of both the high- and low-pressure cylinder, how can the receiver pressure be controlled?

Ques. 2—Why is it unadvisable in a refrigerating plant without an accumulator, to carry the evaporating coils filled with liquid on heavy loads?

Ques. 3—Suppose a water-tube boiler has a mud drum connected to its rear header by six 4-in. nipples. Will there be any greater stress tending to cause the nipples to pull out of the drum when under 100 lb. pressure than when the boiler is cold?

Ques. 4—Is the pressure tending to disrupt a boiler head the same when the head is bumped as when it is flat?

Ques. 5—How many horsepower would be necessary to raise 40,000 lb. 75 ft. high at the rate of 2 ft. per minute?

Ques. 6—If the angle of advance of a *D* slide-valve engine is decreased, will the engine develop more or less power?

Ques. 7—If the number of expansions is the same, will a compound engine develop more power than a simple engine?

Ques. 8—Will water in lubricating oil cause the journals of a Diesel engine to pit?

Ques. 9—How large should be the safety valve on an air receiver?

Ques. 10—Convert 50 deg. C. into deg. F.

Now It's Tennessee!

You can't burn coal twice, but you can make it do double service in any plant where both process steam and power are required. Plant after plant is swinging into line. Next week's POWER *will tell how the Tennessee Paper Company makes power and process steam with the fuel bill that formerly paid for process steam alone.*

EDITORIALS

Does Education Pay?

SOMEONE has remarked that an educated man earns more—sometimes—but that it seldom takes less than ten years after graduation to get educated.

This penetrating *bon mot* obviously uses the word "educated" in only one of its many meanings. If by it we mean merely that a man has acquired a certain modicum of factual knowledge, and a formal familiarity with "canned" thinking, then it is by no means true that the educated man earns more. He may think he does, but the chances are that his boss doesn't. But if we mean that the educated man has developed an intelligent working mastery of machinery and methods and men, how true the statement is!

In this deeply real sense is anybody ever educated? No, never. Such education is not an accomplishment, it is a process. A man's highest duty to himself is to be always and everlastingly on the way, his eyes and ears open to receive data from all sources, some of them the most unexpected, and his mind awake to fit into the whole scheme every bit of information that his senses collect.

It is a tedious, difficult, and sometimes discouraging enterprise, but it is glorious fun, and it is the only way up.

Vibration

USERS and manufacturers of steam turbines alike appreciate the serious consequences of vibration, and the intensive study that has long been directed to the subject by many users and by all the leading manufacturers is well justified by the importance of the subject and its peculiar difficulty. A steam turbine-generator supported by a six-legged steel-and-concrete base is an immensely complex structure, and the analysis of its vibration characteristics is by no means easy.

One large turbine user proposed some time ago to institute a laboratory study of model foundations built about the size of an ordinary table. The project was dropped, however, doubtless because the difficulties of determining the behavior of one structure are bad enough, without attempting to predict the performance of a big one from observations on a model.

Thus far, the curing of vibration is largely in the empirical field of personal skill and "hunch." Fortunately for the industry, there are men who seem to have an uncanny faculty of knowing what to do. Instruments naturally serve them well, but no field instrument yet devised does more than diagnose the trouble.

The article by Mr. Rathbone on another page of this issue, and a second article to appear next week, report the results of his studies, and are a valuable contribution to the literature of power engineering. They indicate that, frequently, much can be done to eliminate vibration by changing the turbine supports, to move the point of resonance as far as possible from the operating speed. Co-operation between turbine and foundation designer will tend to prevent vibration troubles from this source.

But let the buyer beware. Curing vibration is no job for an amateur. If you have a case in your plant, secure the services of an expert.

Flanged Joints For Small-Sized Pipe

CONTINUITY of service is quite generally conceded to be the keynote in modern power-plant practice, and to this end we have seen the development and application of high-grade piping material that has made it possible to meet the demand for increased pressures and temperatures. While this is especially true of the larger sizes, there is evidence of an inclination among designers and contractors to minimize the importance of the small sizes in high-pressure piping in some of the most modern plants. In fact, this piping in many instances is treated much the same as it was twenty or thirty years ago, and the fault will be found more in the application than in the class of material available.

The development of the Van Stone type joint and the acetylene torch has practically eliminated the screwed joint in high-pressure piping in sizes above two-inch. For two-inch and under, however, there is still a tendency to use screwed valves, fittings and unions. In case of leakage of these joints it is common practice to repair them by welding the screwed joints. While this may or may not distort the body of a valve, it eliminates all possibility of replacing it conveniently at some future time. The advantages of a flanged valve or fitting in this case is obvious, provided, of course, that the companion flanges are welded to the pipe.

The difference in cost between screwed and flanged valves should soon be lessened by the increased production as the demand builds up. Even under existing conditions this is almost negligible when compared with the total cost of the job.

The use of fittings can be materially reduced by substituting bends and welded branches wherever practicable. Where the use of a flanged fitting is not justified, a forged fitting, properly welded to the pipe, will be

permanent. A satisfactory method is to ream out the threads of the fitting for a snug fit over the unthreaded end of the pipe with a liberal bevel on the edge of the opening to facilitate welding. This joint is convenient in close quarters where it is impossible to rotate a bend and when otherwise a flanged joint would be necessary.

In ammonia piping, where the smallest leaks are prohibitive, the use of screwed joints is confined to the smallest sizes, seldom over one-half inch. For this service in sizes of one-inch and under, a two-bolt tongue-and groove flange joint is used, which should be satisfactory for the same size of pipe with steam up to four hundred pounds pressure.

Drives for Small Machines

OF LATE years there has been entirely too much attention given to direct-connected drives for small machinery, at the sacrifice of both low first cost and low maintenance.

The chief advantage to be urged for the direct-connected drive is that floor space is conserved. In the case of a steam engine and generator the cost of the unit is considerably higher than the cost of the engine, belt and high-speed generator. The high-speed generator also has the advantage of a better efficiency.

For apparatus such as small refrigerating compressors, belts of special design have been adopted by a number of manufacturers. This arrangement has permitted the operation of the compressor at speeds that result in satisfactory valve action, and at the same time made available the higher speed and more efficient motors.

It is not unusual to find fashions in clothing reverting to those of a decade ago, and this return of belt drive indicates a similar situation in engineering fashions.

Think "Plant" Not "Power House"

WHAT is the "plant"? To one man it means the power house, to another the whole works. The definition gages the man.

To many once and to some even today the engineer's province is a four-walled sanctum of boilers, engines, generators and their auxiliaries. Some still cherish the notion that the sole job of the engineer is to generate power, or, at the most, power and steam for process and heating. "His not to reason why" or ask what happens to them once they are made.

The modern engineer, whatever his momentary title, sees things quite differently. To him the "plant" is the whole works—a single great organism devoted to the complex task of production. He sees within the barbed fence two great divisions of activity: On the one hand, production proper—the actual cutting, forming, treating and assembly of product items; on the other, the *delivery to the point of use* of those services without which production cannot even start.

These services are the job of the engineer, a job big enough to absorb all the brains, energy and experience a man can muster. The mere existence of a well operated power house is small satisfaction to the production man who fails to find the necessary power, heat, refrigeration, compressed air or what not right at his tool or process when he needs it.

The walls of the power house have their uses; they hold up the roof and keep out the rain and cold. That is enough. These walls mean nothing to these arteries that pierce them, carrying power services to vitalize each cell of the great productive organism. Nor do they hem in either the thought or the activities of the engineer who thinks in terms of the ultimate product.

Imagine the Savings!

IMAGINE what a difference it would make in the power consumption of some industrial plants if the bearings on the production equipment were as well selected, lubricated and maintained as the bearings on the equipment in the power plant. Much production equipment is supplied by its makers with inferior bearings, unless the purchaser insists on good bearings as a condition of purchase. Add to this the inefficient lubrication and poor upkeep that production men sometimes accord such equipment, and the resulting waste of power may reach serious proportions.

Unsuitable bearings, poorly cared for, reflect on production costs in ways that are not always evident to the factory management. Most important of these is the increased starting load of the machines which results, throwing an unnecessary burden on the power plant and increasing the cost of generating power, thus making all the finished products cost more. The power engineer is the logical man to select the bearings and to maintain them, for he has experience in doing this in the power plant and he also is responsible for power costs.

When the management of factories where these bearing conditions exist, realizes how much is being spent for power that is wasted in bearings, the elimination of these losses will soon be put up to the power engineer. And, when it is, imagine the savings that will be made!

MANY STILL PERSIST IN COMPARING present conditions and activities with those of 1913. Resulting deductions are not only worthless but misleading, as our whole economic structure has changed since pre-war days. It is far better to take as a yardstick the average of three post-war years, say 1922 to 1924, which fairly represent a period of normalcy.

IDEAS *from* PRACTICAL MEN

Readers are urged to use this department for the exchange of practical operating information. A minimum of five dollars will be paid for contributions accepted

Improvised Automatic Control for Small Return Pump

IT OCCURRED to me that the automatic control I devised for operating a pump to return the condensate of a heating system back to the boiler might be of interest to other readers.

The system was previously manually controlled; that

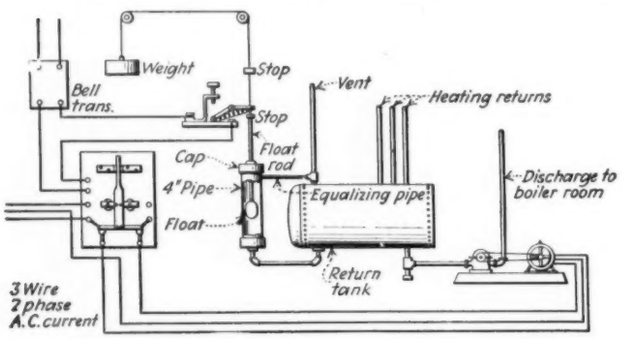


Fig. 1—General arrangement of return pump and controls

is, the tank was allowed to fill up, and if the engineer didn't forget about it, he would go over and start the pump. My employer could not see spending two or three

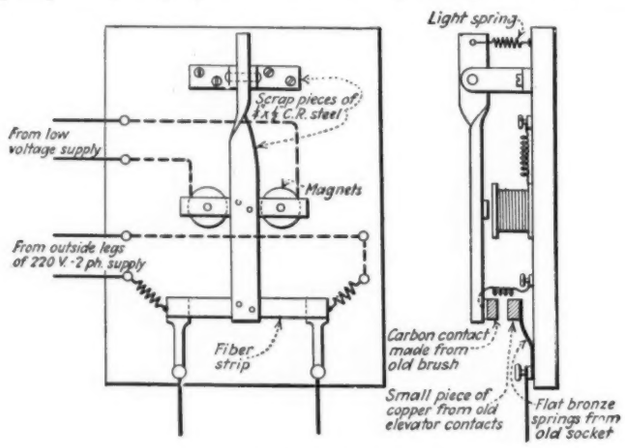

Light spring
Scrap pieces of ¼ x 1 C.R. steel
From low voltage supply
Magnets
From outside legs of 220 V.-2 ph. supply
Fiber strip
Carbon contact made from old brush
Small piece of copper from old elevator contacts
Flat bronze springs from old socket

Fig. 2—Detail of relay switch

hundred dollars for changing the system or spending about the same amount for an automatic outfit. He had the old stock excuse that the system had worked for ten or twelve years and it would be all right to run that way for a few years more. This prompted me to make a control from odd pieces of scrap I could find around the plant.

The assembly of the control is shown in Fig. 1. The return tank is placed above the floor with the pump slightly below it. Fig. 2 shows the detail of the relay switch, which is made up of parts from an automobile horn, elevator contacts, cold-rolled steel strip and other scrap parts.

Fig. 3 shows the detail of the float-operated switch, the main part being made from the snap valve of an old vacuum tank. This, of course, is float operated and has a good snap action for making and breaking contacts. The current from the bell transformer is used to actuate the magnets of the relay switch in Fig. 2. The float was obtained from an old water column.

I had trouble at first with surging of the float every time the traps discharged into the receiver. This would

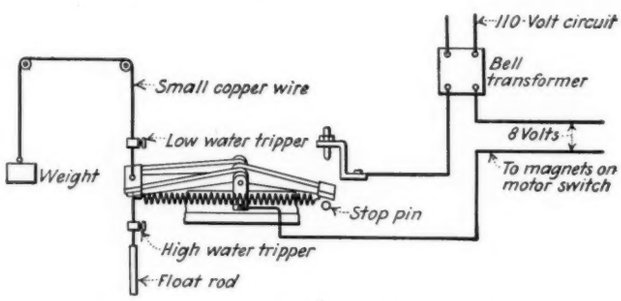


Fig. 3—Detail of float-operated switch

raise the float and automatically start the pump and keep it going until the trap finished discharging. I concluded that the vent on the tank was too small, so I connected the top of the float chamber with the top of the receiver and thus balanced the momentary pressure in the receiver.

I was compelled to use an outside float chamber because the construction of the tank prevented me from putting in a float large enough to operate the motor switch direct. The outside float, of course, was not buoyant enough to operate the motor switch.

Union City, New Jersey — RUDOLPH BOETTINGER.

What the Indicator Showed

THE diagram, Fig. 1, was taken from a low-pressure 64x48-in. vertical cylinder of a rolling-mill engine running at 110 r.p.m. and developing 2,500 to 2,800 hp. The low-pressure reciprocating parts weigh about 14,000 lb., the connecting rod is 11 ft. long and the inertia force is about five times the weight.

The diagram showed the steam distribution when I was

called in; poor compression, late cutoff, and consequently low receiver pressure. Not only did the engine pound badly and run hot on the crankpin, but the bronze boxes of the crosshead-pin end of the connecting rod were continually being scored and ground out, causing much delay and low tonnage, with lots of grief and hard work. The load was poorly distributed between the high- and low-

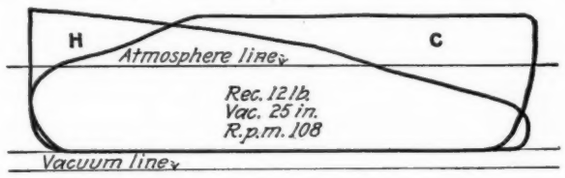


Fig. 1—Diagram obtained before setting the valves

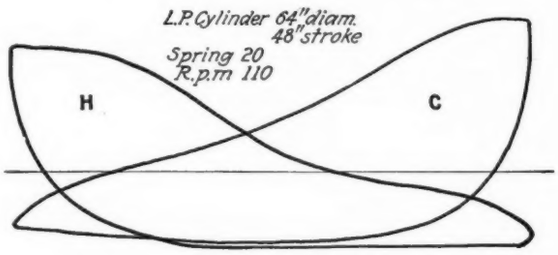


Fig. 2—Diagram shows improved distribution of steam in the cylinder

pressure cylinders, the engineer being afraid to put the load on the low-pressure cylinder by shortening the cutoff, it being adjustable by hand.

The diagram, Fig. 2, shows the steam distribution after resetting the valves. The low-pressure engine has double wristplates with separate eccentric for each. The change consisted chiefly in advancing the low-pressure exhaust eccentric 4 in. around the shaft and adjusting the cutoff to maintain a receiver pressure that would divide the load between the high- and low-pressure cylinders. Since the valves were reset the engine runs quiet and cool with increased output.

D. P. Folton.

Lakewood, Ohio.

Checking Power-Plant Thermometers

THE usual way to check a recording thermometer is to take the bulb out of its well, put a glass test thermometer in the empty well and seal with waste to prevent air cooling. Often oil may be poured in the well, if vertical, and the glass test thermometer submerged therein. The thermometer is allowed to remain thus until the reading is constant. Then the regular recorder bulb is replaced and allowed to come to rest at a constant reading. The pen is then adjusted to the correct reading.

There are two drawbacks to this method:

1. Often the bulb cannot be removed from the well without danger of ruining the thermometer, owing to sediment in the well, or corrosion.

2. The actual temperature of the fluid under test may vary between the time of reading the test thermometer and the replaced recorder bulb.

The best way to overcome this and greatly assist in all test work is to put a duplicate well in the line close to the regular recorder bulb well. This auxiliary well should be of the small glass thermometer receptacle with a screw top to keep out dust, sediment, etc., and should be kept full of oil, so that the true temperature of the flowing medium will be readily obtainable without waiting for it to come to temperature.

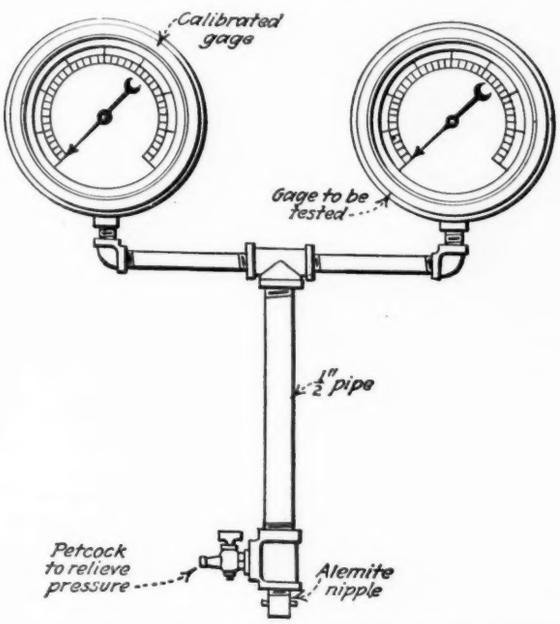
I have made it a point, particularly on steam lines, feed water and high temperature and pressure lines, to place one of these small wells with every recording thermometer. It saves a lot of disagreeable and hot work and makes checking thermometers a pleasure.

Pittsburgh, Pa. L. G. Jones.

A Handy Device for Testing Pressure Gages

IN THE plant where I am employed numerous steam gages are installed on the heating system at various places. Occasionally, these get out of adjustment, and in order that they will continue to serve the purpose for which they were installed, they are periodically checked.

There is a dead-weight tester in the plant, but as it is troublesome to bring each gage back to the shop to have it calibrated, a portable test pump was made, as



Gage tester made from pipe fittings

shown in the illustration. It is made of pipe fittings found around the plant, and the Alemite gun from the jitney is used to furnish the pressure. Lubricating oil is used in place of sperm oil ordinarily used in gage testing. The tester is handy to carry in a tool box, and gives as much satisfaction as an expensive tester pump.

Bozeman, Mont. A. D. Ford.

It Is a Good Plan to Check the condition of the non-return valve regularly at least once a week when a boiler is taken out of service or put on bank. This is readily done by leaving the main stop valve open allowing the non-return valve to cut the boiler off the line. If the valve does not close properly, the pressure will be maintained indefinitely by steam from the other boilers.

COMMENTS *from* READERS

Grouting vs. Bedding Machinery

THE method of dry packing instead of wet grouting of machinery suggested by J. Jordan in the Jan. 10 issue has been in use for many years in the Pittsburgh district. It is especially recommended for any heavy machinery that must absorb severe shocks, such as sole plates, mill housings, roll engine bedplates, bloom shears and any heavy-duty machine having a large area of foundation contact. It is necessary, however, to have a clean washed foundation surface with the machine leveled on shim plates and the foundation bolts pulled down tight. There should be a space of 2 to 2½ in. between the foundation and the machine.

In preparing the grout mix dry equal parts of clean sharp sand and Portland cement, then add water until a handful squeezed in the hand will hold its shape and leave a slight moisture on the hand. Put the grout in from each side to center with ramming bars and ram solid, working from the center out along the entire length to be packed (or around machine as the case may be), being careful that one end or side of the machine is not finished ahead of the other.

Where the machine is heavy and large foundation bolts are used, it is good practice to use an air rammer or sledge for ramming up solid. If the work is properly done, this form of grouting or dry packing will give as lasting and satisfactory a setting as is possible with a cement mixture.

J. S. GREEN.

Oakmont, Pa.

* * * *

Surface-Condenser Heat Transfer

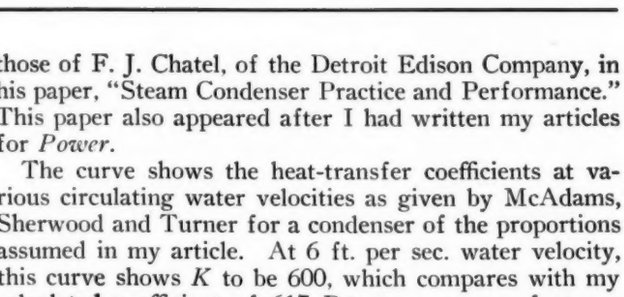
IN THE Feb. 28, 1928, issue of *Power*, a letter from J. J. Alden, of Los Angeles, discusses my articles of April 19 and Nov. 15, 1927, on heat transmission in surface condensers.

No reference was made to the recent paper by McAdams, Sherwood and Turner because it was published after my articles had been written. If Mr. Alden or other condenser designers prefer Professor McAdams' formula and method to the method that I proposed, then there is little of value in my articles except the suggested use of the hexagonal chart which will still be of decided help in using Professor McAdams' formula.

At the time I wrote my articles, I had been able to find no data to suit my method of calculation except that published by Professor McAdams in January, 1922 (*Journal of Ind. and Eng. Chem.*). Mr. Alden suggests that "there are thousands of other more practical tests available."

Unquestionably, there are thousands of condenser tests reported, but they give over-all coefficients of heat transfer that are impossible to separate into their partial-film coefficients. The only tests published giving over-all heat transfer coefficients, that I have been able to use, are those of F. J. Chatel, of the Detroit Edison Company, in his paper, "Steam Condenser Practice and Performance." This paper also appeared after I had written my articles for *Power*.

The curve shows the heat-transfer coefficients at various circulating water velocities as given by McAdams, Sherwood and Turner for a condenser of the proportions assumed in my article. At 6 ft. per sec. water velocity, this curve shows K to be 600, which compares with my calculated coefficient of 617 B.t.u. per square foot per hour per degree F. Referring to Fig. 13 in Professor McAdams' article, page 1249, *A.S.M.E. Trans.*, 1926,



Condenser heat transfer coefficients

it may be seen that his calculated values are conservative, actual over-all operating coefficients being higher than those obtained from his formula.

J. J. Alden objected to my using outside and inside tube coefficients without allowing for differences in area. He says I should have reduced my coefficients in the ratio of 0.510 to 0.73 (or 0.49 to 0.675), but failed to note that I used a 1-in. tube so that the real reduction should have been 0.902 to 1.000. I did not think this worth considering, as it would have given me a coefficient of 755 instead of 815.

Objection is made to my "laboriously combining" two curves to obtain the heat-transfer curve from steam to water. I wasn't keen about it myself, but it had to be done to smooth out the experimental variations in the original data. Combining the data directly will not determine a smooth curve.

The values calculated from separate coefficients proposed by J. E. Bell and Paul Bencel were used to show that their data gave rather high heat-transfer coefficients from the steam to the water side of a tube. They are mostly of historical interest now.

The copper-conductivity figures that I quoted were from Barker. I appreciate that condenser temperatures run from 32 to 125 deg. F., as Mr. Alden states, but as I had the data up to 597 deg. F., I made the curve

originally that way, not knowing to how many uses it might be put. Mr. Alden has added some useful curves for brass.

Mr. Alden has apparently failed to appreciate that I am suggesting that the design of the condenser be split up into *two* parts. In my first article I suggested that, roughly, 25 per cent of the surface be added for the air cooler. At 6 ft. per sec. water velocity the steam-to-water coefficient from Fig. 5 in my April article (page 586, *Power,* 1927) is about 800. Then the average over-all coefficient would be 640. This compares with my more detailed calculation of 617 and with that of 600 from Professor McAdams' Formula. W. J. DANA.

State College Station,
Raleigh, N. C.

* * * *

Stand Ye Prepared

I DROPPED in to see Bill, the chief of the X power plant Saturday, and as I had a recent issue of *Power* with me, I saw a good chance of getting him "off center." Handing him *Power* opened up at the Foreword, "Stand Ye Prepared," I said:

"There you are. Are you prepared? Can you meet the Boss when he comes around with these questions?" I saw by the gleam in Bill's eyes that the pressure was rising and near the popping point. Waving me to a seat, he said:

"Can I meet the Boss? Am I prepared? Say, Buddy, you have been coming here for the last five years, ever since I took hold of the outfit, and every year you and I have had the same experience. Each year the Old Man calls us up and appoints us a sort of ways and means committee, and he certainly gives us the ways, but the means is another horse. You know that every year about this time the Old Man begins to show certain symptoms of the coming spasm, and when it reaches the acute stage, he sends for me and goes over the same old formula. 'Bill,' he will say, 'we must get ready this year to make it the best in our history. The plant is not showing up as well as we would like it to, in the matter of efficiency, and then again I have a letter and a bid here from the P.D.Q. Power Company, saying that they can furnish me all the power that we are in need of for so much per kilowatt-hour. Now I wish you would get hold of Tom, get him out here and go over the plant from start to finish. Make me a complete report of what is needed to bring it up to 100 per cent. I feel sure that we can make and produce our own power just as cheaply as the big power plant, and all that is needed is to put it in the shape to do so.'

"Well, each time, as you know, I have called you up, and for the first two or three times we did go at it with hearts full of hope, but what did we do? Better, what didn't we do? Didn't we show him where every B.t.u. in the coal went? Didn't we make calculations and estimates, take CO_2 readings until the Orsat was dizzy, run the pyrometer ragged with the heat measurements and make a report with indicators diagrams, charts and records enough to fill the *Congressional Record?* Didn't we prove that the saving effected by making certain changes would pay all charges on the necessary investment and retire it in five years? Didn't we show that we were wasting more coal than would be required to bring our cost down below what the power company charged? Didn't we cite the fact that by putting in a modern heating system in the factory, for example, and using the exhaust steam in place of live steam, this would save? Didn't we show that the engines, boilers and the whole works were as full of leaks as a sieve and that he was wasting money from the time the coal went onto the elevator up to the last machine in the whole plant? Didn't we show him? And haven't we been doing this same thing for five years, except for the last two years we simply changed the date on the reports, and added about 3 per cent to our original statement of losses, thus saving ourselves the trouble of going over the same sad old trail again?

"Now the Old Man is beginning to show his annual symptoms, and you may be sure that you will hear from me again pretty soon, so get out the copies of last year's report, knock the dust off, hand it over to the girl in the office and tell her to make a new one, only change the date. Oh, yes, I am prepared, but the dickens of the matter is getting the Boss prepared."

Wilkes Barre, Pa. THOS. M. STREET.

* * * *

Corrosion, not Electrolysis, the Cause of Failure

THE interesting item on a water pipe failure, as given by George I. MacKenzie in the March 6 issue of *Power,* brings to mind a serious cable failure where a thorough investigation disclosed that the cause was not electrolysis, as had been expected, but corrosion.

A company storing some 20,000 tons of Illinois and Indiana coal in a pile from 15 to 18 ft. high on ground specially cleared for the purpose, discovered that soon after heavy rains an electrical lead-covered cable passing below the ground underneath the coal pile would break down. In fact, a number of cable failures occurred in rather rapid succession, being confined entirely to the section of cable below the coal pile.

Investigation showed that the manholes on both sides of the coal pile were nearly full of water, the cables being submerged. The odor in the manhole was strong of illuminating and sewage gas. Upon examination the cables that broke down were found to be badly corroded on the outside around the rupture. The corrosion was not confined to a small area here and there, as is customary in cases of electrolysis, but was found to exist in extensive patches, which immediately suggested attack by a corrosive liquid as the probable cause of the trouble. A close examination showed that the iron supporting pipes in the manhole also were badly corroded.

A chemical analysis of samples of the water in the manhole showed brine and sulphates of iron and magnesium. An analysis of the deposits on the cable sheath showed the presence of sulphites of tin and lead (resulting probably from the action of the hydrogen sulphide in the gas and water contained in the manhole). The presence of the tin was undoubtedly due to the solder of the cable sheath being corroded by the action of the brine and hydrogen sulphide.

The sulphates in the manhole water came from the coal pile. The large amount of brine contained in the manhole water was explained as being due to seepage from an adjacent sewer. The sulphates aided corrosion and, owing to local deposition and decomposition of the source of the acids or brine, weak places in the cable sheath were found out.

Before the ground was leveled and used for coal storage purposes, the manholes were normally dry and would remain comparatively free from stagnant water even after a heavy rainfall. An entirely different situation was created, however, directly the ground was covered with coal to a height of between fifteen and eighteen feet. Where the vacant land allowed the rain to seep away and disappear continuously, the coal pile served to store the water, acting as the equivalent of additional ground surface and calling, therefore, for greater drainage discharge capacity. This being lacking, the drainage became concentrated in existing channels and the manholes would fill up and flood, the sewage and the seepage from the coal pile finding their way into the manhole and staying there long enough to do damage.

This instance is particularly interesting because it shows that the condition was not brought about by electrolysis, which was the first and quite natural hypothesis. It shows, further, that the actual primary cause of the trouble may be relatively far removed from the seat of the trouble. It also stresses the fact that cause and consequence may easily be confused, particularly where consequence removes the cause. K. RANKIN.

Chicago, Ill.

* * * *

Is Volumetric Efficiency Important?

THE article, "Is Volumetric Efficiency Important?" by Thomas M. Gunn, in the Feb. 7 issue, is a timely exposition of the facts. Mr. Gunn has handled his subject in a most thorough manner. Certain definite conclusions may be drawn from his article, and it is to be regretted that these were not more concretely stated.

It is recognized that, assuming tight valves and pistons, a loss of volumetric efficiency due to clearance with slightly superheated suction does not impair the over-all efficiency of the compressor, as the energy required in the compression is returned to the piston. As Mr. Gunn so ably points out, wiredrawing or friction through the valves is an economic or power loss. He treats only of wiredrawing through the suction valves, but the suction and the discharge valve friction must be added together to determine the resulting increase of power used.

Obviously, the lesson to be drawn by the designer is to make valve areas and cylinder port passages exceedingly liberal even if in so doing large cylinder clearance results. The piston displacement of the machine may be easily increased to compensate for the slight volumetric loss due to larger valve area, whereas the wiredrawing losses resulting from compromising the valve area to secure a lower clearance can never be recovered. While not necessarily so, yet usually, high volumetric efficiency and low horsepower per ton of refrigeration do not occur together in a single-stage compressor, since to secure the close clearance for high volumetric efficiency, large valve area is most frequently sacrificed, with consequent high horsepower.

Another conclusion of importance to be drawn from Mr. Gunn's article is the rapidly increasing rate of loss from so-called heat slip with increase in cylinder temperature. Obviously, the higher the temperature of compressor cylinder the lower the volumetric efficiency and the higher the horsepower per ton of refrigeration. Fortunately, we can, by proper design of the compressor cylinder and by the use of two-stage compression when total compressions exceed approximately six, keep the loss from heat slip entirely within reasonable limits. The importance of two-staging when low temperatures are produced should never be overlooked by the refrigerating engineer. H. H. MILLER.

Cincinnati, Ohio.

Answers to "What Do You Know?"

The questions are on page 605

Ans. 1—Adjust the length of the governor reach rods connected to the valve gear of the low-pressure cylinder.

Ans. 2—There is danger that the rapid ebullition will cause liquid to be carried over to the compressor. If the coils are only partly filled, the gas has an opportunity to free itself of liquid before it leaves the coil.

Ans. 3—Yes, the stress is greater when the boiler is under pressure. Under either condition the stress on the nipples consists of the weight of the drum and contents plus the pressure exerted by the head of water in the boiler acting on an area equal to the cross-section area of all the nipples. When under steam pressure, the pressure exerted by the water column is its weight plus the steam pressure.

Ans. 4—Yes, the pressure tending to separate the head from the shell is the same, being the product of the projected area and the unit pressure.

Ans. 5—A horsepower is defined as the work equivalent to that done in the lifting of 33,000 lb. 1 ft. per minute. There is 40,000 lb. that is being lifted at the rate of 2 ft. per minute, or 80,000 lb. of work per minute is being done. Divide this by 33,000 and we have 2.4 + horsepower that is being developed while you are doing this work. This is the rate at which work is being done—that is, at the rate of 2.4 hp.—but the work is continued until the weight is lifted 75 ft., and since we are doing it at the rate of 2 ft. per minute, we are taking $75 \div 2 = 37.5$ minutes to do it. Consequently, the work done would require $2.4 \times \frac{37.5}{60} = 1.5$ hp.-hr., and the work is being done at the rate of 2.4 horsepower.

Ans. 6—It will develop more power. Decreasing the angle of advance causes all the valve events to occur later. Cutoff will be later, permitting the engine to take steam for a longer interval; this raises the mean effective pressure and increases the amount of torque the engine can overcome.

Ans. 7—No. The power will be the same, but owing to the greater cylinder condensation caused by the large temperature range, the steam consumption of the simple engine will be greater than that of the compound.

Ans. 8—No. The pitting is due to an acid condition of the oil, and the water has no effect. The water might, however, cause corrosion if the engine is shut down for a long period.

Ans. 9—The valve must be designed to handle the full capacity of the compressor with not over a 10 per cent increase in pressure. The A.S.M.E. Code for Unfired Pressure Vessels states that a valve shall not exceed 3 in. in diameter and gives a table showing the capacity of valves of various diameter at different pressures.

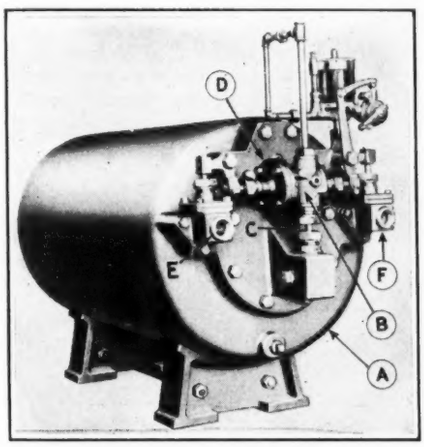
Ans. 10—The formula for transfer of Centigrade to Fahrenheit readings is $F = \frac{9}{5}C + 32$. In the question, C is 50 deg., so $F = 122$ deg.

New and Improved EQUIPMENT

"Shortt" Simplified Pumping Trap for Water and Other Liquids

THE W. B. Connor Company, Inc., 369 Lexington Ave., New York City, has recently introduced a pumping trap known as the "Shortt."

The trap is designed to function equally well on steam or compressed air and is adapted to a variety of services,



Stationary receiver with all operating valves on the outside

including the pumping of high- and low-temperature liquids such as oils, condensates, gasoline, etc., the draining of condensers, receivers and similar equipment, and the feeding of boilers.

The basic feature underlying the design of the trap is the controlling of the pressure and vent valves by means of a small piston valve. This feature has simplified the construction of the trap by eliminating the need for a pivoting and counterweighted receiver.

Briefly, the construction and operation of the trap is as follows: To the head of the stationary receiver is fastened a plate on which are mounted all the operating valves, there being nothing inside the receiver but the float.

When the receiver *A* fills, the float rises, opening the cylinder control valve *B* by means of the valve rod *C*. This allows steam or compressed air, as the case may be, to flow into the operating cylinder *D* and cause the piston in the cylinder to move to the right. This movement first closes exhaust valve *E* and then opens the high-pressure steam or air valve *F*. The steam or air then flows into the receiver and forces out the liquid. When the liquid has lowered to the sealing level, the float opens the control valve *B*, admitting steam or air to the opposite end of the cylinder *D*, and reverses the direction of movement of the piston. In moving back, the piston first closes the high-pressure valve *F*, shutting off the steam or air to the receiver, and then opens the exhaust valve *E*, permitting condensate or other liquid to flow again into the receiver. When steam is used to discharge the liquid, it is vented back to the unit being drained, so that practically no steam is lost and the amount of steam consumed is small.

Among the claims made for this trap by the manufacturer are large capacity, positive action and the elimination of wiredrawing through the quick full-opening of the steam valve.

Quigley Bitumen Gun

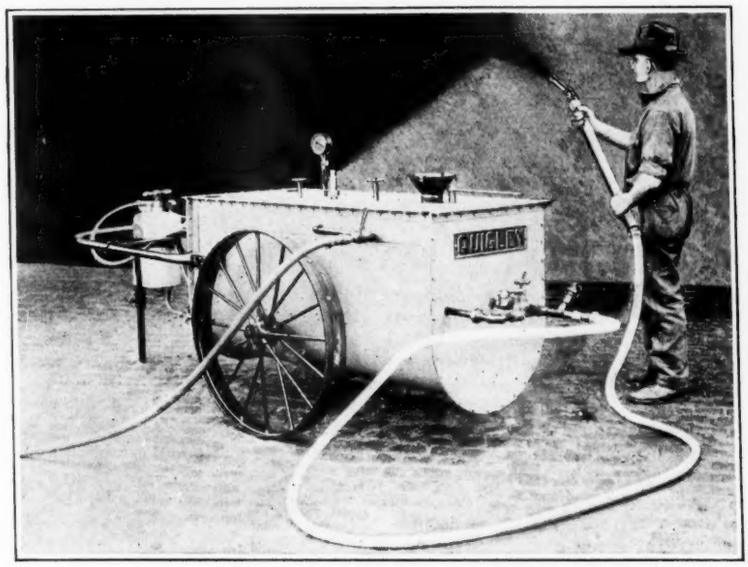
THE illustration shows the new bitumen gun recently developed by the Quigley Furnace Specialties Company, 26 Cortlandt St., New York City.

The new gun, which is an adaptation of the Quigley refractory gun made for some years by this company, is designed especially for applying hot tar, asphalt or other waterproofing materials to concrete foundations, interiors of water tanks and reservoirs, and applying protective coatings to pipe lines, penstocks, flumes, etc. The new gun is similar in many respects to the refractory unit. It consists of a cast-iron cylinder from which the material is forced by a piston to which pressure is applied by compressed air. The compressed air is never in contact with the material, nor is it used to form the spray, this being a purely mechanical process. Fifteen cubic feet of air a minute at 60 lb. pressure is given as the amount of air required to operate the gun.

For hot spraying, preheated material is put into the cylinder above the piston through a charge opening in the top of the machine. The temperature of the material in the gun is maintained at the proper point by a small self-contained kerosene burner, a large-scale thermometer being conveniently placed in view of the operator.

A special insulated metallic hose is used, and it is claimed that the machine will discharge the material any distance up to several hundred feet with a drop in temperature of not over three degrees for each 25-ft. length. The discharge end of the nozzle can be turned at an angle and special nozzles are available for certain requirements.

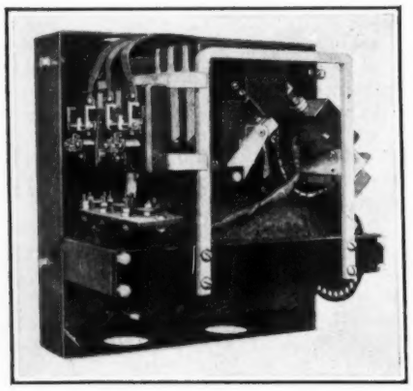
The gun is completely inclosed in a steel housing mounted on wheels and is readily moved from place to place. It has a capacity of fifteen gallons, or sufficient to cover about 400 sq.ft. of surface with one filling.



Bitumen gun in operation

Reactance Starter for Squirrel-Cage Motors

A NEW automatic starter for use with squirrel-cage motors has been recently brought out by the Lincoln Electric Co., Cleveland, Ohio. This starter is of the induction type, having a reactance coil that is connected in series with the motor leads, to give reduced voltage at starting. As the motor comes



Squirrel-cage motor starter with the cover removed

up to speed and the current decreases to a predetermined value, the reactance coil is short-circuited, which automatically connects the motor winding to line voltage.

This starter has two adjustable features. One of the adjustments is in the starting current and is made by changing the position of the core in the reactance coil. This core is index mounted, and the starting current of the motor is increased by going to the higher numbers of the scale and decreased by going to a lower.

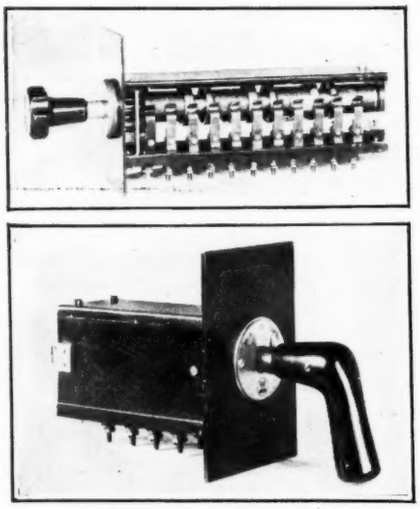
The other adjustment is in the current at which the throw-over from reduced to full voltage takes place. The throw-over is controlled by a retarding solenoid, which is operated by the motor current. The pull of this solenoid can be adjusted by a simple lock-rod arrangement that is carried on its plunger.

The motor is controlled by the conventional start and stop buttons. When the start button is pressed, it applies reduced voltage to the motor and the starting current is held within predetermined limits. As the motor comes up to speed the current decreases, and when it has fallen off to the desired amount the switch is automatically thrown to the running position without interrupting the current to the motor. The motor is removed from the line by pushing the stop button. Overload protection is afforded by thermal relays and the no-voltage protection by no-voltage release coils.

When the front cover is removed, the switch may be swung forward after taking out the holding screw at the back. This brings the switch mechanism out where it is in a better position for observation. The arcing barriers may also be moved upward, out of the way. By the release of a screw on the control switch panel the contact carrying arm will drop back, exposing all contacts for renewals or observation.

New Instrument and Control Switches

THE Westinghouse Electric & Manufacturing Company has recently put on the market a new type of switch used for connecting any instrument or group of instruments selectively to various circuits as may be required for metering, synchronizing, or for other switching functions. These switches, as shown in the figures, are of the rotary type. They are especially adapted for mounting in small space, and present a uniform appearance which will harmon-



Top—Instrument switch. Bottom—control switch

ize with instruments and similar apparatus on switchboards.

The turning of the switch handle operates a shaft on which are mounted various contact-making segments. These segments make or break contact with stationary fingers supported on an insulated base. This base is a part of the supporting structure of the switch with suitable top and sides serving to enclose the switch parts completely, and to complete the switch structure.

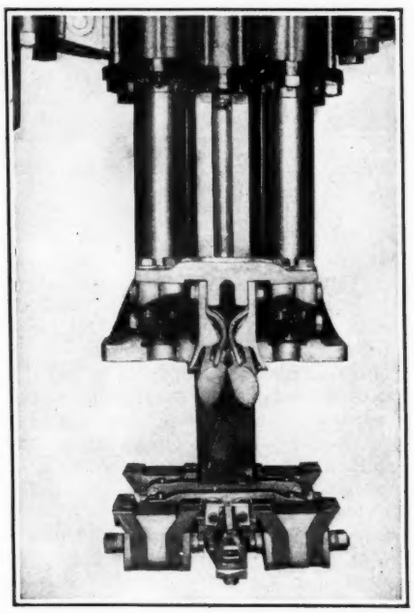
These switches are readily mounted on any commercial thickness of panel and are made in six standard lengths. The many combinations required are assembled from a relatively small number of standard segments and insulating arc-resisting spacers. All switches are insulated for 600-volt service alternating current and direct current. The contacts will carry ten amperes continuously and will open five amperes under normal conditions.

New Heavy-Duty Oil Circuit Breaker

THE Westinghouse Electric & Manufacturing Company has recently added the Type 0-55 circuit-breaker to its indoor line for generating-station service. The new circuit breaker is built in 4,000, 5,000 and 6,000 ampere capacities at 15,000 volts, with a rupturing capacity of 2,500,000 kva. at 15,000 volts.

Mounted in a complete structure, the breaker units are supported from the top plate which also carries the operating mechanism. This method of mounting places the barrier walls in compression, utilizing their maximum strength. Condenser-type terminals are used to pass the conductors through the main base. The contacts, as shown in the figure, are of parallel path construction, with wedge-type arcing contacts. The arcing contacts are heavier than on lighter breakers to take care of the increased rupturing capacity.

Carried on a plate and channel-iron structure, which is bolted to the top of the barrier walls, is the electric mechanism. This mechanism consists of a double solenoid designed so that the pull of the closing mechanism closely matches the effort required to close the breaker units at all points of the closing stroke. This gives adequate speed of closing for synchronizing, and at the same time keeps down stresses within



Contacts in open position on 4,000-ampere breaker

the structure. A control relay panel is also included in the closing mechanism. The control relay removes the energy from the electric mechanism immediately upon the completion of the closing stroke. The breaker cannot be held closed, either electrically or mechanically, if the tripping relays disengage the trigger.

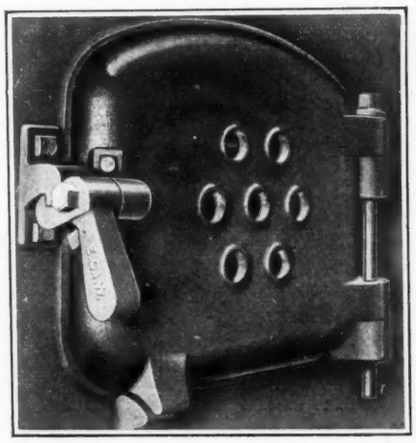
Erie City Safety Latch for Furnace Doors

AN IMPROVED safety latch for boiler-furnace firing doors, designed to conform to the requirements of any State Inspection Department, has been brought out recently by the Erie City Iron Works, Erie, Pa.

The latch, which is counterweighted and made to engage the latch block on the boiler front from the bottom, is hinged on the door with a stop so placed as to limit the throw of the latch in either direction.

In opening the door the counterweight is raised until the latch strikes the stop; this releases the catch, and the counterweight then serves as a handle for opening the door. The stop also limits the throw of the counterweight in the other direction, so that the door will latch automatically when pushed shut.

A properly shaped lug is provided at the bottom to raise the door to the right level for proper latching should there be considerable freedom in the hinge bolt.



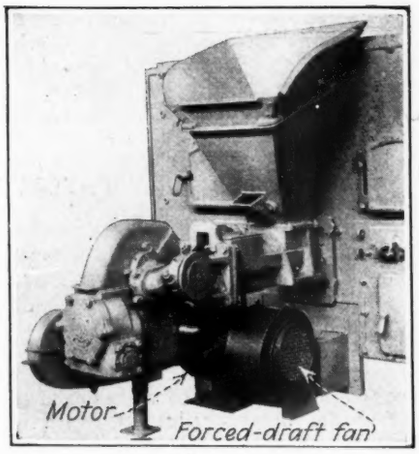
Firing-door safety latch

New Jones Stoker Unit

THE combining of the fuel feeding mechanism, the forced-draft fan and the driving motor into one unit, constitutes an important improvement recently made to the Jones stoker, manufactured by the Riley Stoker Corporation, Worcester, Mass.

The fuel feeding mechanism including the gear box, which is fitted with roller bearings, is the same as that used on the Riley underfeed stokers. The driving motor and forced-draft fan are assembled with the fan direct-connected to the motor shaft, the two being mounted at the front of the stoker and below the feeding mechanism. The other end of the motor shaft carries the silent-chain drive for the stoker, the complete motor and chain being inclosed in a dust-tight cover.

By virtue of these improvements the stoker has been made self-contained, and the necessity for a separate fan foundation and drive, and the building of an air duct to connect the fan with the air chamber are obviated.



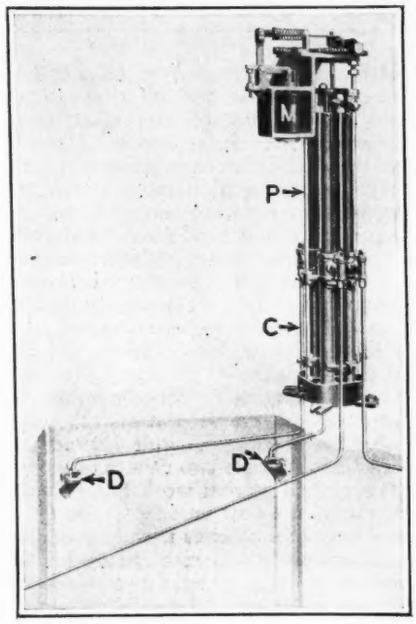
Front view of stoker with motor drive and forced-draft fan

Pressure-Type Guide-Rail Lubricator

THE figure shows a pressure-type elevator guide-rail lubricator developed by the Otis Elevator Company, Yonkers, N. Y. This device is electrically operated and, as a unit, automatically lubricates the four guide rails. Oil in the four cylinders *C*, one for each guide rail, is forced out by the downward motion of the pistons *P*. After being forced out of the cylinders, the oil flows by gravity through copper tubes to the distributors *D*, which deliver it to the three surfaces of the rails.

Magnet coil *M* is energized by the car-closing a switch in the hoistway or by a selector switch. When this coil is energized, it works a ratchet that turns a threaded shaft to lower the plungers into the cylinders. The stroke of the ratchet is adjustable so that the amount of oil delivered to the guide rails each time the magnet switch is closed, can be made proportional to the installation requirements. The quantity of oil supplied to the guide rails varies directly as the need for lubrication, as the lubricator delivers oil to the rails only when the elevator is in operation and in proportion to the number of trips made.

The lubricator is placed in the penthouse, where it can be easily inspected and refilled without taking the car out of service.



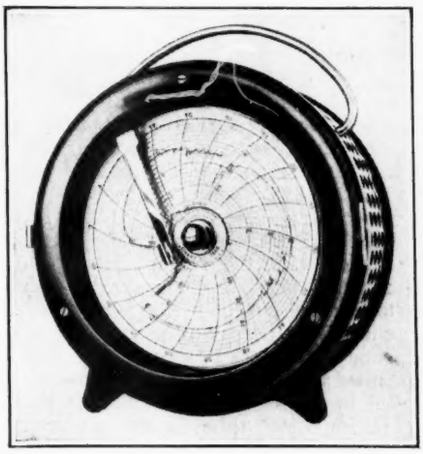
Lubricator in position with oil leads to guide rails

Bristol Small Atmospheric Recording Thermometer, with Four-Inch Charts

THE latest addition to the line of recording thermometers made by the Bristol Company, Bristol, Conn., is the small instrument illustrated.

The new instrument uses 4-in. charts designed to give clear readings over appropriate ranges. The instrument is self-contained, being used without leads or other form of connections. The case is fitted with convenient handle and leg rests and is designed to permit of mounting on wall, post or other support.

The pen arm is attached to the measuring element and records directly on the chart without the aid of any intervening multiplying devices. A special frictionless form of inverted pen arm with fountain pen is standard equipment, the pen carrying a sufficient supply of ink to give a uniform record line over the complete chart revolution of 72 hours. The clock used has all parts plated to safeguard against any possible action of moisture.



Atmospheric recording thermometer

Industrial Steam Engineering

By Alfred J. T. Taylor

THE industrial engineer's important place in the engineering profession and his value to industry has not been generally recognized. This paper has been written to show that, if he had proper encouragement and support, he might render immense service to British industry, especially in textile mills, sugar refineries, breweries, dye-works, and all similar industries using steam for cooking or other processes, which form a large and important part of the industrial activities of this country. The man who should have supervision of the design and operation of steam plants essential to these industries and have an audible voice in the organization and conduct of all the processes that depend upon steam and power for their economical working, is what, for the purpose of this paper, I shall call an industrial engineer. The term is not, of course to be confused with that of efficiency engineer.

Very little has been written or spoken about industrial steam engineering as a distinct branch of the profession. Direct and often mistaken criticism has been leveled against our industrial plants. Much has been said about their inefficiency. Some critics would have a wholesale scrapping of industrial steam plants. Lamentations are heard all over the country about the coal that is being wasted. But there is abundant evidence to show that the real problem of the industrial plant is not generally understood. The truth is that efficiency, as reflected in the saving of fuel, while of prime importance in a central electricity station, is of minor, and sometimes of no real importance in an industrial plant. The important thing is the economical production of whatever goods the factory in question has to manufacture.

The real object of industrialists should be to develop engineers who, instead of having only an efficiency—or rather a B.t.u.—point of view, have as well a production—or financial—point of view, and who are capable of relating whatever is done or proposed to be done in the factory steam or power plant, or in the heat or power consuming apparatus, to its ultimate effect upon the profits of the company concerned.

Problem of Industrial Plants

The foremost problem now confronting designers is the reduction of initial investment in the plant, so that the curves for fixed charges and total cost may be turned downward. This desire to reduce fixed charges is having a modifying effect on the trend of steam-station design, particularly in endeavors to secure increased output out of standard equipment and to reduce building volume.

Let there be no misunderstanding in regard to my view of efficiency. Coal, of course, must not be wasted, and getting the utmost value in steam and power produced from every pound of coal burned should be strongly insisted upon. But in the factory power plant let efficiency be kept in its proper place, that is, as secondary to the economic production of goods.

In the extremely rapid changes that have taken place in industry during the last fifteen years and in the disruption due to the war and its consequences, the development of an industrial engineering conscience and a recognition of the real differences between the central-station engineer and the industrial steam engineer have been delayed. Let me explain that fundamental difference.

Just as in the United States the duties of the engineer of an industrial plant are being expanded to include the transmission, application and maintenance of power plant services, Great Britain is feeling the need for this change. The situation there is well described in a paper by Alfred J. T. Taylor, member of the institution of Engineers and Shipbuilders in Scotland, recently read before that body. An abstract of that paper is given herewith.

Stationary steam plants can be broadly divided into central stations, where the output is electricity, and industrial stations, where the output is steam and sometimes power. It is important to show why, when the steam plant equipment is for the most part identical in the two cases, there is, nevertheless, a wide gulf between the functions of these two classes of station. The central station work has naturally attracted the best engineers, the plants are large, the salaries usually good, and the engineer's influence among his fellow-citizens is generally considerable. So today the limit in central station design, with the materials and pressures presently available, is being approached.

There is no anxiety about the future of central stations. Capable consultants, progressive manufacturers, well-financed owners, and a rapidly expanding market for electricity at good prices, with an almost unlimited supply of engineers anxious to undertake central station design or management, insure this future. Great associations of executives who frequently exchange experiences, and an excellent international feeling among central station engineers of all countries, have contributed to produce central stations that may now be said to manufacture one kilowatt-hour of electrical energy on a heat consumption of 15,000 B.t.u. or less.

Competition Causes Progress

Competition among manufacturers of equipment is largely responsible for progress in central station design. The desired end is apparent—to produce electricity at the minimum cost. The consulting engineer renders valuable service in determining many factors before the station is built, such as its size, location and probable growth. He adjudicates between competing builders of equipment so that his client may receive what is best for his conditions at the desired time. Then, again, competition is responsible for the increased size of units and their increased efficiency by the use of higher pressures and temperatures, and also for lower capital costs. Witness the new 160,000-kw. turbine-generators for Hell Gate station, New York, followed by a 208,000-kw. set for State Line station, near Chicago. Only last week one of the largest European builders of turbines said that he was prepared to accept an order immediately for a 320,000-kw. set whenever it was required.

From the professional point of view the obvious inference is that central station work will be less attractive to thoughtful young engineers as it becomes more standardized. It is almost axiomatic in engineering that the less original thought is required the smaller the remuneration to the thinker will be. For this reason our young technical men should have their attention directed to industrial engineering and its possibilities.

If the industrial problem were simply to design and build economical steam plants, the central station engineer could handle it perfectly. But that is not the whole problem; it is only one part of it. The proper relation of the steam plant to the particular industry is the vital thing that calls for more than the ordi-

nary technical knowledge of the steam plant itself, and requires the special experience of the industrial engineer. This country has scores of able steam engineers; the whole world is short of competent industrial steam engineers.

Importance of Industrial Power Plants

The fact that the industrial steam plant equipment is similar to that in a central station is largely responsible for the mistaken belief that the problems are identical in each. It is supposed that, because one plant is on a smaller scale than another, the man in charge of the industrial steam plant need not be so well trained technically, and that he can be set to produce steam or power, often without regard to the peculiarities of its consumption in the plant. Moreover, he is usually paid a wage considerably less than that paid for similar work in central stations.

Plainly, the necessity for an industrial steam engineer, who must be a great deal more than a boiler room foreman, has not been generally recognized. So there are numerous cases of industrial firms whose output is seriously limited by their steam plants, who often maintain a so-called efficiency in the boiler house at the expense of production, and who frequently buy power when they should produce it themselves as a by-product of their steam requirements. Such firms are found making unnecessary, and often haphazard, improvements in boiler room equipment, and in general regarding the production of cheap steam as the desirable thing, without thinking whether the various processes in the plant are securing an adequate amount of steam and power in such a way as to insure the maximum quantity of the desired quality of goods.

Let me repeat that adequate steam and power when and where needed are what is required, whereas efficiency, as represented in the saving of coal, is a secondary matter. Production by the intensive utilization of the whole plant is the matter of prime importance. The industrial steam engineer must think of the economics of the factory as a whole and not of savings in the steam section alone. He needs all the basic information of the central station engineer, plus the knowledge of everything that requires heat or power in the industry he serves. Some of the best industrial steam engineers have graduated from central stations, acquiring their special experience in industry.

It is a fact that the vital relation between output and net profits in an industrial plant is not generally so well understood as it might be, particularly by those responsible for the engineering side of the business. With the factory closed down, there is a minimum expense which is a loss composed of fixed charges—rents, rates, taxes, and so on. As operations are begun, the cost of labor, material, fuel and supplies is added to these charges. Varying with the industry, it requires from 15 to 22 days of operation per month before the value of the output equals its total cost. This is in all industries the critical point. Below that certain output there is a loss, and when it is passed there is a profit; but once the critical point is passed the rate of profit very rapidly increases.

Many industries, the sulphite pulp industry for one, usually operate with an output beyond the critical point representing about 10 per cent net profit. If the output can be increased by only 20 per cent, by methods not involving additional expenditure on plant, the net profit in this particular industry will be increased approximately 100 per cent. The fact that the profit increases rapidly after the critical point is passed, shows how important it is to keep the factory running at its full capacity, and also how seriously hindrances to maximum production can affect the profits of the factory.

> *"If the industrial problem were simply to design and build economical steam plants, the central station engineer could handle it perfectly. But that is not the whole problem; it is only one part of it. The proper relation of the steam plant to the particular industry is the vital thing that calls for more than the ordinary technical knowledge of the steam plant itself, and requires the special experience of the industrial steam engineer."*

Losses Must be Checked

Everyone who is in any way connected with the great industrial problems of the present day is vitally concerned with the subject of preventable losses. Broadly as well as definitely considered, all the questions of today depend for their ultimate solution upon a thorough and exhaustive analysis of preventable losses. The loss incurred through inefficient and insufficient production is, from my particular point of view, the greatest preventable loss in industry today, and I am firmly convinced that waste of effort cannot be checked and real industrial-plant efficiency attained until there are more thoroughly competent industrial steam engineers.

There is no shortage of promising material from which to develop such engineers. But the industrial executive must provide the opportunities and recognize the pressing necessity in his business of developing engineers who see beyond the steam plant, and who must be allowed and encouraged to find out just what efficient use is being made of the heat and power generated there. Hitherto, adequate salaries have not been offered and full scope for initiative and a voice in the counsels of the management have not been given to such men. In this world we usually get what we pay for and no more, and we have not been paying nearly enough for our industrial steam engineers.

The industrial steam engineer is much too isolated at present. He should form associations of his fellows, at least among those in his own type of industry. They should meet and discuss, as informally and as frequently as possible, their various problems of operation and their experiences with new equipment. Members of these associations should submit problems for discussion, not to take the form of papers, but of free talks of a confidential nature among themselves. A movement of this sort should receive every encouragement from the industrial executives.

Why should men operating similar plants each have to make the same original experiments and usually the same mistakes? The day of industrial secrets is over. There is more to be gained from a free exchange of experience than from special little tricks jealously guarded as in former days. Industries, to prosper, must broaden both their knowledge and their sympathies. The so-called good old days have passed when the individual plant owner could, and often did, defy everyone else in the same industry and follow his independent course, neither giving nor receiving information. Manufacturers in other countries have learned that a free interchange of technical experience pays all concerned. A large share of the rapid development of central stations has been due to the adoption of this plan and to the free interchange of experience.

There is another point. Competition forces the producer not only to do his best with his own factory, but inevitably to co-operate with others, and we shall certainly see the exchange of gas, heat and power between neighboring factories that have a surplus of one or the other. There is sufficient importance in this one idea alone to warrant some able men giving its development their entire attention. The plan has been adopted in parts of Europe, and it merits most careful consideration in this country. Industrialists must be careful to see that legislation is not passed in this country that will prevent this free exchange of gas, power or heat. This is not an idle warning; restrictive legislation has been passed in some countries with the view of benefiting the central stations.

Why should not a tire mill with a surplus of, say, 3,000 kw. continuously, as a byproduct of its heat requirements, send this surplus of electrical energy to neighboring plants at a profit? Or might it not be possible to interchange power with a central station, taking power from the latter during off-peak periods and possibly at night? The central station engineer cannot be expected to

guard this possible avenue to great economy; it is for the industrial engineer to safeguard and develop.

Boiler Room Limiting Factor in Industry

Out of nearly two thousand studies of industrial plants made in this and other countries by myself and associates, over 70 per cent have shown that the boiler room has been a limiting factor in production, and that some processes have suffered, or have been delayed, through an inadequate steam supply or through fluctuating pressures. These investigations further show that over one-half of the plants should and could supply their own power for considerably less than they could possibly purchase it. I can say with confidence that in any industrial plant where both power and heat are necessary, there are the strongest financial motives for considering the advantages of producing power as a byproduct of the heat required for process. These studies also showed that the standard of engineering in the majority of these plants was below what it should have been. In many cases the engineer had no direct contact with the executive at all, and usually was asked to concern himself only with the steam plant.

The blame for these conditions rests upon several parties. The manufacturer of equipment has not a little to do with this through his incessant advocacy of efficiency. Many a good executive with no technical training will discount such talk by a process of simple reasoning. For he will say, "My total coal bill is only so much, and if this enthusiast for new boilers, stokers, or what not, saves the lot, it will not appreciably affect our dividends." The executive may or may not be right in any particular case. But he is always right in being wary of the recommendations of sales engineers who would improve his industrial steam plant, unless they have a thorough knowledge of the factory itself. An intelligent managing director, even though non-technical, is vastly more satisfactory to deal with than a plant engineer who is fearful of exceeding his authority and ignorant of the commercial side of his employers' business.

The far-sighted executive of today will not hesitate to invest money in engineering brains. The best solutions to his problems are not to be found by the men of mediocre training or experience. Where consulting engineers are employed, those should be selected who are experienced and competent in industrial practice.

Manufacturers Render Help

I think it is high time that the service manufacturers of engineering equipment render to the entire community should be generally recognized, and that sales engineers who know their business should receive more consideration from purchasing executives. Both industrial and central station engineering would be a long way behind today's level if it were not for the efforts of the manufacturers of equipment. The whole development, for instance, of mechanical stokers for the last twenty years has been brought about by stoker manufacturers. But in spite of this there are still men who in spirit at least, are inclined to agree with the sentiment of Napoleon's time, which classed all those who made and sold things as being among the lowest forms of animal life, and who give little attention to the representations of sales engineers.

If there is one shortcoming in the present courses of technical training, it is that young engineers are not brought into intimate practical contact with all the processes in one or other of the heat-using industries. I have questioned a number of technical graduates as to the relation existing between the boiler house, and, say, the half-dozen distinct processes requiring steam in a sugar refinery, and I have invariably found them totally ignorant of the real requirements of these processes as related to the operation of the boiler house.

A great many engineers seem to believe that, once a factory has its boiler plant, all that remains to be done is to keep it running, burning as little coal as possible, and to endeavor so to arrange the factory processes that fluctuations in the demand for steam are reduced to a minimum. Few engineers think of the advisability of increasing the fluctuations, and thereby possibly reducing the boiler efficiency, in order to get greater production and better quality goods. Yet this is the viewpoint of the industrial engineer. The steam plant must be the servant of the factory, not its master.

When an Employer Is Liable for Acts of Employee

By Leo T. Parker

IN MANY litigations involving the liability of an employer for damages as a result of injuries sustained, or caused third persons, by employees, the outcome of the controversy turns on whether the employee was acting within the scope of the employment when the accident occurred.

Frequently, persons confuse the terms "within the scope of the employment" and "in the service of the employer." It is important to know that an employer may or may not be liable for negligent acts done by an employee who is in the service of his employer, but the employer always is liable for injuries negligently effected third persons by an employee who acts within the scope of the employment.

Also, an employee who is injured "while serving his employer" may not be "acting within the scope of the employment" when the injury is sustained. Under the former circumstance the employee may or may not be entitled to compensation, but he always is entitled to compensation for an injury sustained as a result of the negligence of his employer, while working within the scope of the employment.

It is interesting to observe that in a recent case, Carpenter vs. Tressel, 125 N. E. 804, the Court in explaining the rule for determining whether an employee acts within the scope of the employment, said:

"The rule is well settled that an agent binds his master only as to acts done within his actual authority, or within the apparent scope thereof. A servant is acting within the scope of his employment when he is engaged in doing for his master what he has been directed to do, or any act which can fairly and reasonably be deemed to be an ordinary and natural incident or attribute of that act, or a natural, direct and logical result of it."

It has been held on numerous occasions that a workman is acting without the scope of the employment, irrespective of the time when the act is done, if at the time in question he has, without the knowledge of his employer, discontinued work at the task set aside for him to do, unless such discontinuation is for the purpose of doing something reasonably necessary in the ordinary course of his regular duties.

In the recent case of Turner vs. American District Co., 110 Atl. 540, the Court said:

"It matters not that the employee's working hours have not expired or the task to which he has been especially assigned been finished. If he turns aside from his work or task to do something unrelated to the master's business, he is, as long as he is engaged, as much acting outside the scope of the employment as he would be were his working day ended or task completed."

Generally, an employer is not liable for the negligent acts of an employee as a result of which another employee is injured, providing the two employees have equal authority to perform the work being done, and the injury was not caused through negligence of the employer (147 U. S. 101).

On the other hand, if an employee is injured through the negligence of another employee who is his foreman, boss, or the like, the employer is liable, unless it can be shown that the contributory negligence of the injured employee was the proximate cause of the injury. But simply because a superior workman negligently injures an employee does not make the employer liable if neither employee had direct authority over the other.

NEWS *of the* FIELD

Hope Seen for Passage of Bill Authorizing Federal Power Commission to Appoint Its Own Personnel

Senate Committee Favors Measure Despite Opposition of House—May Pass at Present Session, Attached to Other Legislation

FAILURE of the bill authorizing the Federal Power Commission to employ its own personnel to pass the House may not mean that such legislation will not be enacted into law at this session of Congress. It is known that the Senate Committee favors the bill and that it has a chance to pass the Senate. An effort will be made to attach the measure to some other legislation, with the possibility that it may be brought before the House again this session for another vote. The bill was rejected in the House by the close vote of 179 to 168.

OPPONENTS FEAR LARGE NEW BUREAU

The principal argument advanced against the measure was that it would make possible the building up of a new bureau. Some of those who addressed the House predicted that the passage of the measure would result in another government agency of the size of the Interstate Commerce Commission. Representative Garrett, the minority leader, said that he had seen "bureaus grow like Jack's bean stalk. Whenever I am driven to the point where I have to take the choice between a monarchy and a bureaucracy I shall choose the monarchy. Fortunately, we do not have to take either. We have a republic if we will only maintain it, but we cannot maintain it by voting at every opportunity to create a new bureau or to enhance beyond measure the power of some bureau already in existence."

MERRILL ATTACKED FOR RUNNING WHOLE SHOW

O. C. Merrill, the executive secretary of the Federal Power Commission, was accused of "running the entire water-power show." It was declared that the Cabinet officers composing the Commission do not have time to pay much attention to the matters coming before the agency and that Mr. Merrill, in fact, executes the authority vested in the three secretaries. On the other hand, Chairman Parker, of the Interstate and Foreign Commerce Committee, stated that the secretaries fix the policies which the staff carry out. Even some of those who criticized the bill expressed the opinion that Mr. Merrill is a conscientious, hard-working government official.

It was apparent from the debate that there is strong objection in the House to federal activities calculated to place unnecessary burdens or annoyances on business.

Whiting Corp. Opens Foundry Research at Mellon Institute

Announcement has been made by Dr. Edward R. Weidlein, director of the Mellon Institute of Industrial Research, Pittsburgh, that the Whiting Corporation, Harvey, Ill., has established in the institution an industrial fellowship, the holder of which, Dr. Edward E. Marbaker, will conduct research on cast iron. The results of these investigations will be published for the general benefit of the foundry industry.

For a number of years the Whiting Corporation has been carrying on a systematic program of development for the purpose of improving equipment and methods for the production of cast iron.

Doctor Marbaker has been a fellow of Mellon Institute since 1921. Previously he was chief chemist for the Westinghouse Lamp Company and for the Cleveland Wire Division of the National Lamp Works of the General Electric Company. He received his professional training at the University of Pennsylvania.

Commission to Withhold No Findings in Utilities Probe

All facts gathered by Federal Trade Commission examiners and those secured from other sources in investigating the operations and management of public utilities will be made public in the form of evidence, it has been announced by the Federal Trade Commission in explaining that the public hearings necessarily will have to be confined largely to the propaganda phase of the investigation of the public utilities.

In accordance with the provisions of the Senate resolution the Commission expects to withhold none of the results of its general investigation.

Military Committee Favors Muscle Shoals Operation by Government

For the first time in years that the Muscle Shoals problem has been before Congress the House Military Committee March 28 declared itself in favor of government operation of the vast properties in Northern Alabama.

By a vote of 17 to 4 the committee approved the new Morin bill proposing the creation of a federal corporation charged with the operation of the properties for the manufacture of commercial fertilizer. The corporation also would be directed to keep the properties in such condition that nitrate production could be speeded up in time of war.

The corporation would consist of five members to be appointed by the President with the Senate's approval and an appropriation of $10,000,000 would be authorized to provide working capital.

The committee rejected the Madden bill proposing that Congress accept the bid of the American Cyanamid Company.

Engineering Courses Planned for Summer Session at Carnegie Tech

Courses in engineering subjects are receiving special attention in the plans for the eleventh summer session this year at the Carnegie Institute of Technology, Pittsburgh, according to an announcement.

The College of Engineering, a recent statement says, will give summer courses in chemistry, physics, mechanics, surveying and coal mining. In the College of Industries courses are scheduled in welding, sheet-metal work, machine practice, woodworking and cabinetmaking, electric wiring and printing and plumbing and engineering drawing.

The summer work is being outlined to cover both theoretical classroom instruction and shop practice, to appeal not only to the undergraduates, but also to those engaged in engineering work who feel a need for more technical training in their respective fields. Courses of six and eight weeks will be given, beginning June 11.

Prominent Engineers to Lecture on Fuel and Gas Topics at M.I.T.

As a part of the course in fuel and gas engineering, at the Massachusetts Institute of Technology, a series of lectures by men who possess special knowledge of important phases of gas manufacture will be given during April and May.

"Coke Oven Construction and Operation," by D. W. Wilson, Wilputte Oven Corporation, will be presented April 6; on April 16, "Purification of Gas," by Dr. F. W. Sperr, Jr., The Koppers Company; April 27, "Low-Pressure Distribution," by R. S. Carter, Malden & Melrose Gas Light Company; May 4, "High-Pressure Distribution of Gas," by A. W. Grant, Jr., The Koppers Company; May 11, "Handling of Coke and By-products" will be offered by A. M. Beebe, general superintendent, Rochester Gas & Electric Corporation.

Plant Studies Follow Classroom

The course in fuel and gas engineering at Technology is now in its third year. During the first two years nine graduate engineers completed the work and are now employed in various branches of the fuel and gas industries. This course is open to graduate engineers and consists of nine months' work at the Institute, followed by six months' field work at stations which are located at Cambridge Gas Light Company, Cambridge, Mass., Edgar Station of the Edison Electric Illuminating Company of Boston, Lackawanna Works of Bethlehem Steel Corporation, Mineral Springs Plant of Iroquois Gas Company of Buffalo, and at Bayonne Refinery of the Tide Water Oil Company.

The period at the Institute is largely spent on those aspects of the subject that can best be learned in the classroom and laboratory. The field work, which consists of plant studies and testing of full-scale equipment in normal operation, is carried out under the immediate and personal supervision of an Institute instructor.

D'Annunzio Opens Big Italian Hydro-Electric Station

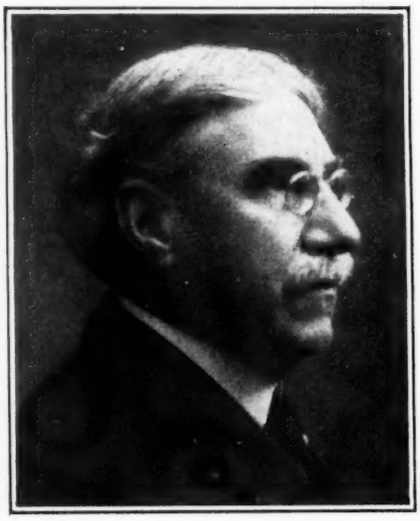
Signor Gabrielle D'Annunzio, the famous Italian poet, recently exploded the last mine to be fired in connection with the erection of the hydro-electric plant of the Ponale (Province of Trent) power station, located near Riva, at the northern end of the Lake of Garda.

The plant is one of the largest in Italy, and uses the difference in height of 1,935 ft. between the Lake of Leydro and the Lake of Garda. The fall is 1,968 ft. at an angle of 45 deg. The maximum productive capacity is 100,000 hp. The intake of the water is near the village of Mezzolago, 70 ft. below the level of the Lake of Leydro, which is fed by subterranean streams and by two torrents. From this point a tunnel 3¾ miles long, bored through the rock of Monte Oro, leads to the Lake of Garda.

The power developed by the plant will be carried by high-tension lines to Verona, Mantua, Modena and Bologna. It is estimated that in this way Italian industries will save 250,000 tons of coal yearly.

W. F. M. Goss, A.S.M.E. Past-President, Twice Engineering Dean, Dies

Prof. William Freeman Myrick Goss, president of the American Society of Mechanical Engineers in 1914 and formerly on the engineering faculties of Purdue University and the University of Illinois, died at the Hotel Waldorf, New York City, March 23.



Prof. W. F. M. Goss

Doctor Goss was born at Barnstable, Mass., in 1859. At Massachusetts Institute of Technology, in 1877, he entered the then recently established course in mechanical arts, and two years later he began the development and organization of a similar course at Purdue, finally becoming dean of the School of Engineering. He left that university in 1907 to assume the duties of dean of the College of Engineering at Illinois University and professor of railway engineering and director of the School of Railway Engineering and Administration.

Career of Wide Activities

In 1917 he resigned from the University of Illinois, when he was elected president of the Railway Car Manufacturers Association, from which he retired in 1925.

Professor Goss was chief engineer of the committee of investigation on smoke abatement and electrification of railway terminals in Chicago from 1913 to 1915.

In 1888 he was given the degree of Master of Arts by Wabash College, and in 1904 he was honored with the degree of Doctor of Engineering by the University of Illinois. He was further honored by appointment on the National Advisory Board on Fuels and Structural Materials and was a member of the Jury of Awards in the Transportation Department of the World's Fair at Chicago. He was also a member of the Society for Testing Materials, Society for the Promotion of Engineering Education, Western Society of Engineers, fellow of the American Association for the Advancement of Science, member and past-president of the Western Railway Club, and one time chairman of the advisory committee of the Pennsylvania Railroad charged with testing locomotives at the Louisiana Exposition.

For many years Doctor Goss was a contributing editor to the *Railroad Gazette*, and he was the author of numerous papers on railway and stationary prime movers and related mechanical subjects.

Ontario Premier Fears Power Shortage in Near Future

Addressing the Ontario Legislature recently, Premier Ferguson expressed alarm at the power situation in the province, fearing a shortage of power in a very few years. Even allowing for a possible increase of 500,000 hp. on the Ottawa River, a possible million horsepower from the St. Lawrence development and a possible 500,000 hp. from additional diversion at Niagara Falls, which might be arranged by international treaty, it would not be long, the Premier thought, until all the available power would be utilized. He stated that the power consumption of the province was increasing at the rate of 100,000 hp. yearly.

Booster System to Be Employed

The province, however, could not be sure of these three sources of power, the Premier pointed out. At present the Dominion government is claiming rights on the Ottawa and St. Lawrence Rivers. The matter, however, had been referred to the Supreme Court, and undoubtedly would be carried to the Privy Council for final settlement.

In view of the uncertainty of the future supply of power, experiments were being made with a "booster system," which would enable power to be transported great distances. Should these experiments work out successfully, the Hydro Commission might be able to transport power from sources in Northern Ontario, which are wholly within the control of the province. Otherwise, they would have to depend for their requirements on jointly-owned sources.

The Premier hoped the province would get its first supply of power from the Gatineau development next fall. The contract was for 30 years, and he expressed the wish that it had been for a longer period, as he felt sure the power would be required even on the completion of developments in Ontario.

Recent Permits for Power Developments Authorized

A preliminary permit for the White River Power Company of Little Rock, Ark., was authorized at a meeting of the Federal Power Commission held March 26. The company's plan provides for the construction near Cotter of a storage dam 226 ft. high. Other dams and power houses below Cotter on the White River and on its Buffalo and North forks are planned. It is estimated that 70,000 hp. of primary power will be made available. It is planned to install 165,000 hp. A conflicting application by the Ozarks Hydro-Electric Company was withdrawn recently.

The application of the Western Washington Electric Light & Power Company for a preliminary permit on North River in Washington also was authorized by the commission. It is planned to install 40,000 horsepower.

A license was authorized for the St. Croix Falls Improvement Company covering a project on the St. Croix River in Wisconsin. It is proposed to install 66,500 hp. at Kettle River Rapids and at Nevere.

Discuss Plant Materials at A.S.T.M. Meetings

Coal and coke, the corrosion of iron and steel, the effect of high temperatures on the strength of iron and steel, specifications for lap-welded and seamless pipe, and carbon steel castings for high-temperature work were among the subjects discussed in meetings of 24 committees of the American Society for Testing Materials, held in Washington, D. C., on March 21, 22 and 23. Nearly five hundred members of the Society gathered at the Mayflower Hotel solely for committee group meetings, of which ninety-four were held in all.

Much Work Accomplished

Committee A-1 on Steel revised the specifications for marine boiler plates to make the marking requirements correspond with those given in the Department of Commerce Steamboat Inspection Rules. Specifications for lap-welded and seamless steel pipe were changed to permit single welding of pipes used for flanging and Van Stoning and to reclassify seamless steel pipe into grades A and B instead of low and medium carbon. The committee decided that the present state of the art did not warrant preparation of a specification for materials for use at 1,000 deg. F. and 1,200 deg.

Work on sampling and tolerances was discussed by Committee D-5 on Coal and Coke. The subcommittee on this subject, which is co-operating with the Prime Movers Committee of the N.E.L.A., is well along with a preliminary study. With the assistance of the United States Bureau of Mines sampling data are being secured on several shipments of high-, medium- and low-volatile coal. It is hoped that the report will prove of such value to large coal consumers and producers and to various engineering, gas and technical societies that funds will be forthcoming for a continuation of the investigation on a broader scale under the supervision of the Bureau of Mines.

Committee D-15 on Thermometers announced that it hopes to co-operate with a section of the A.S.M.E. Power Test Code Committee in the preparation of specifications for thermometers.

High Temperature Fatigue to Be Studied

Progress was reported by the Joint Research Committee of the A.S.M.E. and A.S.T.M. on the effect of temperature on the properties of metals. In addition to further reports on short-time tests, one laboratory submitted its report on flow tests. It is expected that laboratory work on fatigue at high temperatures will be under way in the near future.

A bibliography prepared by this committee was examined in proof form and will be available to the public in a five weeks, it was announced.

German Power Plants Show Marked Progress

Owing to greater activity in industry and a heavier demand from domestic consumers, last year was one of increased sales by the generating stations of Germany, according to the report for the year recently presented to the annual meeting in Berlin of the German Association of Electrical Engineers.

This growth in demand led to a corresponding extension of generating plants. New constructions included the great Klingenberg power station in Berlin, the Neuhof power station at Hamburg, the Bohlen station at Leipzig, and the Kachlet water power plant at Passau belonging to the Rhine-Main-Danube.

The formation of the Ryburg-Schworstadt A. G. may be mentioned; by utilizing the water power of the Rhine, approximately 90,000 kw. capacity will be obtained by this company.

Early Use of Benson Boilers

The steam power stations recently erected are, in the majority of cases, equipped with steam pressures between 450 lb. and 600 lb. Higher pressures are projected—for example, of 1,500 lb. in the case of extensions to the Mannheim power station. Further, the Benson boiler is now so highly developed that its early use in power stations can be expected. Greater attention is being paid to the utilization of waste heat from the boiler plants of power stations. Following the example of Hamburg, reorganization for this purpose is in progress in Berlin, Liberfeld and Zeitz.

The main problem in power-station construction, and one which has not been satisfactorily solved, is the carrying of peak loads. Reference is made to the use of Diesel motors, water-storage stations, and Ruths accumulator plants for this purpose. So far three of the latter plants have been laid down in Germany. In the sphere of turbine machinery large outputs are prominent, orders being placed for turbines with outputs up to 55,000 kva. Large rectifier plants, principally for street railway operation, have been manufactured in considerable quantities.

Along the entire line of electrical machinery, and especially in the sphere of series motors, new and more efficient products have been produced, representing an essential improvement on previous designs, mainly owing to the bearings of the rotor.

General Electric Issues Statement—Earnings $48,799,488

Earnings of the General Electric Company for 1927 amounted to $48,799,488, equivalent, after dividends on the special stock, to $6.41 a share on the 7,211,481 shares of no par common stock, the annual report of the company recently made public today by President Gerard Swope, disclosed. This compares with $6.14 a share in 1926.

Orders received during the year 1927 were $309,784,623, compared with $327,400,207 in 1926, a decrease of 5 per cent; and unfilled orders at the end of the year were $68,916,000, compared with $72,297,000 at the close of 1926, also a decrease of 5 per cent.

The company's manufacturing plant investment at the end of the year had a cost value of $200,896,984, but deducting $141,538,281 in depreciation reserves and $9,020,331 added during 1927, the book value was $50,338,371, or $219,018 less than at the end of 1926.

Investments in associated companies are carried at $90,330,622, compared with $71,472,186 at the end of 1926. The larger part of the increase of $18,858,435 resulted from advances to enable associated companies to call outstanding bonds.

Personal Mention

S. T. Baum, formerly mechanical inspector for the Brooklyn Edison Company, is now with McLeod & Henry as sales engineer.

Justin G. Smeby has been recently appointed welding engineer at the South Philadelphia Works of the Westinghouse Electric & Manufacturing Company.

W. A. SLATER has just been appointed research professor of engineering materials and director of the Fritz Engineering Laboratory in the Department of Civil Engineering of Lehigh University.

J. A. HALE, chief engineer of the Utah Power & Light Company, has been assigned to study the problems of the St. Francis dam in San Francisquito valley, near Los Angeles, in compliance with orders issued by company officials recently.

HERBERT HOOVER has been appointed a member of the Endowment Committee for Engineering Foundation and Engineering Societies Library, and its executive subcommittee. He has accepted this appointment, it has been announced by the board of trustees.

A. D. WILLIAMS, formerly with the United States Steel Corporation, recently accepted the position of general superintendent at the factory of Alexander Brothers, Inc., manufacturers of leather belting and other mechanical leathers, 14 South St., Philadelphia.

Society Affairs

AMERICAN WATER WORKS ASSOCIATION, Florida Section, will hold its second annual meeting at the San Juan Hotel, Orlando, April 3-4; E. L. Filby, secretary, P. O. Box 135, Jacksonville, Fla.

PROVIDENCE ENGINEERING SOCIETY—At 8 o'clock, April 3, the power section, A. E. Cameron, chairman, will be addressed by Melvin D. Engle, assistant to superintendent, station engineering department, construction bureau of the Edison Electric Illuminating Company of Boston, speaking on "The First Commercial 1,200-Lb. Steam Plant in the World."

A.S.M.E. joint meeting with the WESTERN SOCIETY OF ENGINEERS at the Monadnock Building, Chicago, April 9. "Power Plants and Equipment of Office Buildings," by E. P. Rich, Neiler, Rich & Company, Chicago. There will be a discussion on elevators and ventilating problems.

A.S.M.E., METROPOLITAN SECTION, Engineering Societies Bldg., 29 West 39th St., New York City, April 11. "Proposed Method of Rating Steam Generator Units," by W. A. Shoudy, consulting engineer, New York City, and W. H. Jacobi, manager of the Keokuk Steel Casting Co., Keokuk, Iowa.

A.S.M.E., METROPOLITAN SECTION, Engineering Societies Bldg., 29 West 39th St., New York City, April 17. "Performance Records of Oil Engine Locomotives," by Herman Lemp, consulting engineer, Ingersoll-Rand Company.

Coming Conventions

American Association of Engineers, annual convention, El Paso, Texas, June 4-6; M. E. McIver, secretary, 63 Adams St., Chicago.

American Institute of Electrical Engineers, Balitmore Regional Meeting, District No. 2. April 17-19; New Haven Regional Meeting, Northeastern District, No. 1, in May; Summer Convention, in Denver, June 25-29.

American Institute of Refrigeration, Washington, D. C., May 10-11.

American Order o fSteam Engineers, convention at Atlantic City, N. J., June 11-14, and exhibition with American Supplymen's Association. Address Fred L. Jahn, Watson of McDaniel Company, 146 N. Seventh St., Philadelphia.

American Refractories Institute, annual meeting at White Sulphur Springs, W. Va., May 8-9; Dorothy A. Texter, secretary, 2202 Oliver Bldg., Pittsburgh.

American Society of Refrigerating Engineers, meeting at Detroit, June 4-7; W. H. Ross, secretary, 37 West 39th St., New York City.

American Society of Heating and Ventilating Engineers, Summer meeting at West Baden Springs Hotel, West Baden, Ind., June 26-29; A. V. Hutchinson, secretary, 29 West 39th St., New York City.

American Society of Mechanical Engineers, spring meeting in Pittsburgh, May 14-17; Calvin Rice, secretary, 29 West 39th St., New York City; Twin-City regional meeting at St. Paul, Aug. 27-30; Boston regional meeting, Oct. 1-3.

American Society for Testing Materials, Atlantic City, June 25-29.

American Water Works Association, Annual meeting, Hotel Fairmont, San Francisco, June 11-16; W. M. Niesley, 170 Broadway, New York City.

Association of Iron and Steel Electrical Engineers, annual convention and Iron and Steel Exposition at Hotel Stevens, Chicago, June 25-29.

Indiana Fuel Conference at Purdue University, Lafayette, Ind., April 5-6.

National Association of Power Engineers, annual convention at Detroit, Sept. 11-15, and concurrently National Exhibitors' Assn. exhibit; Fred Raven, 417 South Dearborn St., Chicago. New England States Association convention at Hartford, Conn., June 21-23; K. W. Lundberg, secretary. Foot Guard Armory, Hartford.

National Board of Boiler and Pressure Vessel Inspectors, meeting at Erie, Pa., June 18-20.

National Electric Light Association, Convention and exhibition, Atlantic City, N. J., June 4-8; A. Jackson Marshall, secretary, 420 Lexington Ave., New York City.

National District Heating Association, annual meeting at Ambassador Hotel, Atlantic City, June 12-15; D. J. Gaskill, sec., 112 West 4th St., Greenville, Ohio.

Stoker Manufacturers Association, fall meeting at Greenbrier Hotel, White Sulphur Springs, W. Va., Oct. 22-24.

Universal Craftsmen Council of Engineers, Newark, N. J., Aug. 7-10.

Second Bituminous Coal Conference will be held at Pittsburgh, Nov. 19-22.

A.S.M.E., DETROIT SECTION, Detroit Engineering Society at 8 p.m., April 24. "Low Temperature Distillation of Coal" by A. R. Smith, General Electric Co., Schenectady, N. Y.

Fuel Prices

COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; mine run, except **Pittsburgh gas slack:**

Bituminous (Net Tons)	Market Quoting	Price per Ton
Navy Standard...	New York.....	$2.25@$2.50
Kanawha.....	Columbus.....	125. @ 1.60
Smokeless.....	Cincinnati.....	2.25
Smokeless.....	Chicago.....	2.25@ 2.50
S. E. Kentucky...	Chicago.....	1.35@ 1.65
Steam.....	Pittsburgh.....	1.40@ 1.65
Gas Slack.....	Pittsburgh.....	1.10@ 1.25
Big Seam.....	Birmingham...	1.50@ 2.00
Anthracite (Gross Tons)		
Buckwheat.....	New York.....	$2.75@$3.00
Birdseye.....	New York.....	1.60

FUEL OIL

New York—Mar. 29, industrial use, tank-car lots, 28@34 deg., Baumé, 4¾c. per gal.; 36@40 deg., 5¾c. per gal., f.o.b. Bayonne, N. J.

St. Louis—Mar. 31, tank-car lots, f.o.b. St. Louis, 24@26 deg., $1.58 per bbl.; 26@28 deg., $1.63 per bbl.; 28@30 deg., $1.68 per bbl.; 30@32 deg., $1.73 per bbl.; 32@36 deg., gas oil, 4.4c. per gal.; 38@40 deg., 5.105c. per gal.

Pittsburgh—Mar. 20, f.o.b. local refinery, 30@34 deg., fuel oil, 5c. per gal.; 36@40 deg., 5¼c. per gal.

Philadelphia—Mar. 21, 26@30 deg., $2.00@$2.06 per bbl.; 13@19 deg., $1.26 @$1.32 per bbl.; 22 plus, $1.58@$1.64 per bbl.; 27@30 deg., $2.10@$2.16 per bbl.

Cincinnati—Mar. 20, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 4.9c. per gal.; 26@30 deg., 5.15c. per gal.; 30@32 deg., 5½c. per gal.

Chicago—Mar. 17, tank-car lots, f.o.b. Oklahoma, freight to Chicago, 90c. per bbl.; 22@26 deg., 85@90c. per bbl.; 26@30 deg., 90@95c. per bbl.; 30@32 deg., $1.10 per bbl.

Boston—Mar. 19, tank-car lots, f.o.b. 12@14 deg. Baumé, 4.35c. per gal.; 28@ 32 deg., 5.8c. per gal.

Dallas—Mar. 24, f.o.b. local refinery, 26@30 deg., $1.40 per bbl.

LEWIS INSTITUTE BRANCHES OF THE A.I.E.E. AND WESTERN SOCIETY OF ENGINEERS, 1951 West Madison St., Chicago, have announced their second annual engineering exposition, to be held May 16-18.

AMERICAN WATER WORKS, MISSOURI VALLEY SECTION, will hold its fourteenth annual meeting Oct. 2-5 at the Kansas City Athletic Club, Kansas City, Mo. Jack J. Hinman, Jr., P. O. Box 313, Iowa City, Iowa, is secretary.

Business Notes

WILLIAM K. CAPERS, formerly tank salesman for Wm. B. Scaife & Sons Company, Pittsburgh, is now manager of the Chicago office.

THE LINCOLN ELECTRIC COMPANY, Cleveland, announces the appointment of Jacob F. Savela as welding service manager for the Detroit district under the direction of J. M. Robinson, district sales manager.

THE MCCLAVE-BROOKS COMPANY, the New York office of which has been located at Room 1609, 1440 Broadway, for the past three years, moved March 15 into larger quarters in that building, at Room 2302.

THE NATIONAL FLUE CLEANER COMPANY, Groveville, N. J., manufacturer of soot blowers for fire-tube boilers, has recently appointed as its representative in New England the Furnace Improvement Company, 511 Westminster St., Providence, R. I., and in Chicago Naylor-Hickey Corporation, 643 Washington Blvd.

THE BROWN INSTRUMENT COMPANY announces that it has secured larger quarters for its Detroit branch at 576 Maccabee Building. R. W. Mayer is district manager.

THE D. C. JAMES MANUFACTURING COMPANY, Chicago, manufacturing all types of speed reducers and cut gearing, announces the addition to the sales department of R. C. Bird, in the capacity of traveling sales manager. Mr. Bird, formerly with the Chain Belt Company, of Milwaukee, has spent some twenty years in working with power-transmission equipment.

READING STEEL CASTING COMPANY, Bridgeport, Conn., has announced the following changes of location and duties in sales personnel. Wallace McCausland, who has been district sales manager in Pittsburgh for a number of years, has been transferred to the general sales office of the company at Bridgeport, Conn., to assume the duties of assistant to the general manager of sales; A. W. Taggart, for the last three years district sales manager in Chicago, has been returned to the Pittsburgh district to assume the district sales managership; Walter E. Foster, who has had headquarters at the Bridgeport office of the company as sales engineer, is transferred to the Chicago office to become district sales manager. Previous to his association with the Reading Steel Casting Company, Mr. Foster was Chicago manager for the Ingalls-Shepard Forging Company for a number of years.

SANDVIK STEEL, INC., manufacturers of steel conveyor belts and belt conveyors, Woolworth Building, New York City, has announced that the company's conveyor department is now known as the Sandvik Conveyor Manufacturing Company, with general offices and factory located at 21-23 Amsterdam St., Newark, N. J.

THE DAMPNEY COMPANY OF AMERICA, Hyde Park, Boston, announces that the sale of its Apexior protective coatings for power-plant equipment will be handled in North Carolina, South Carolina, Florida, Tennessee, Georgia, Alabama, Mississippi and Louisiana by Neville & Cleary, Inc., main office, Candler Building, Atlanta, and with branches in New Orleans and Tampa.

NEW PLANT CONSTRUCTION

Calif., Aroma—Aroma Public Utility Dist., F. E. Cole, Secy., will soon award contract for the construction of a waterworks system including well, turbine pump and motor, tank on tower, etc. J. B. Benedict, R. A. Box 131, Hanford, is engineer.

Calif., Glendale — Bd. of Education, awarded contract for the construction of a group of high school buildings including central power plant, etc. to C. Thoren, 5615 West 4th St., Los Angeles. Estimated cost $796,400.

Conn., Windsor Locks — Northern Connecticut Power Co., 15 Central St., Thomasville, has been granted license for a hydro-electric project, here. No contracts have been awarded. J. G. White Engineering Corp., 43 Exchange Pl., New York, is engineer. This corrects report in Mar. 6 issue.

D. C., Washington—Southern Ry. System, plans the construction of an office building at 15th and K Sts. N. W. Estimated cost $2,000,000. W. B. Wood, 816 Connecticut Ave. N. W., is architect.

Ill., Chicago — Chicago Daily News, 17 North Wells St., awarded contract for the construction of a 23 story printing plant and office building at Madison and Canal Sts. and Washington Blvd. and Chicago River, to Heggeman-Harris Co., 431 North Michigan Ave. Estimated cost $10,000,000.

Ill., Chicago—G. E. Holmes, 34 East Lake St., will soon award contract for a 10 story garage at Lake and Dearborn Sts. Estimated cost $1,000,000. D. D. Meredith, 222 West Adams St., is architect.

Ill., Chicago — Hyde Park State Bank, 5300 Lake Park Ave., awarded general contract for a 10 story bank and office building at 53rd St. and Lake Park Ave., to Merick Construction Co., 1954 East 71st St. Estimated cost $1,000,000.

Ill., Chicago—Syndicate, c/o Equitable Bond & Mortgage Co., 180 West Washington St., awarded contract for masonry, etc. for a 12 story apartment building at 67-75 East Elm St. Estimated cost $1,000,000.

Ind., Fort Wayne—City Council and Bd. of Works, awarded contract for remodeling power and light plant to Froehleich & Emery Engineering Co., Second National Bank Bldg., Toledo, O. Estimated cost $200,000.

Ind., Indianapolis—F. Meiere, 1701 North Illinois St., had revised plans prepared for a 12 story hotel including steam heating system, elevators, etc., at 14th and Pennsylvania Sts. Estimated cost $800,000. F. B. Hunter, 912 State Life Bldg., is architect.

Ia., Burlington—Iowa Soap Co., Valley St., plans the installation of a power plant in connection with proposed factory addition. Estimated total cost $110,000. Federal Engineering Co., Central Office Bldg., Davenport, is engineer.

Ia., Lake Charles—J. Finger, 422 Marine Bank Bldg., Houston, Tex., Archt., will soon receive bids for a 10 story hotel including steam heating system, elevators, etc. at Ryan and Puyo Sts. here, for H. T. McCain & W. R. Weber. Estimated cost $600,000.

Mass., Boston—Hospital Dept., will soon award contract for the construction of a boiler house at City Hospital, Albany St. Estimated cost $200,000. J. H. Ritchie & Associates, 250 Stuart St., are architects.

Mass., Boston—Penal Institutions Dept., will receive bids until Apr. 9 (extended date) for the construction of a power house at Deer Island, Boston Harbor.

Mass., Cambridge (Boston P. O.)—Boston Ice Co., 110 State St., Boston, awarded contract for the construction of an ice plant at Second and Charles Sts. here, to Vappi & Ferguson, 552 Massachusetts Ave., Cambridge.

Mass., Waltham (Boston P. O.)—Dept. of Mental Diseases, will receive bids until Apr. 6 for the construction of a pump and transformer building at Metropolitan State Hospital. Private plans.

Mich., Bellevue—Village, G. Lesser, Clk, will soon award contract for the construction of a waterworks system including sinking of four driven wells, electrically driven centrifugal pump, mains, etc. Estimated cost $65,000. Burd, Giffels & Hamilton, 407 Kelsey Bldg., Grand Rapids, are engineers.

Mich., Ferndale—Detroit City Service Co., Lafayette Bldg., Detroit, awarded contract for the construction of an ice plant at Woodward Heights here to Pine & Munnicke, 510 Murphy Bldg., Detroit. Estimated cost $50,000.

Mich., Jackson—Sparks Withington Co., Le Roy St., awarded contract for the construction of a radio factory, 60 x 260 ft. and power plant, 30 x 40 ft. to North Moller Co., 120 West Cortland Ave.

Mich., Plymouth—Detroit House of Correction, Alfred St., Detroit, plans the construction of a group of buildings including heating plant, etc., here. A. Kahn, 1000 Marquette Bldg., Detroit, is architect.

Miss., Calhoun City—City will receive bids until Apr. 17 for the construction of waterworks and distribution systems including pumping plant, etc. Morgan & Co. Inc., Edwards Hotel Bldg., Jackson, are engineers.

Mo., Kansas City—J. H. White, 532 Lee Bldg., awarded contract for an 11 story office building at 1227 Grand Ave., to O. O. Concannon, 1227 Grand Ave.

Mo., St. Louis—Syndicate, c/o McKelvey-Carter Construction Co., 3800 West Pine Blvd., Contrs., awarded contract for a 15 story apartment building at 4630 Lindell Blvd. Estimated cost $1,200,000. Steam heating and electric refrigeration systems, etc. will be installed.

N. J., Asbury Park—S. T. B. Land Co., S. B. Shanckman, Pres., 17 Atterbury St., Trenton, is having plans prepared for a 5 story hotel, stores and theatre building including steam heating system, boilers, etc. at St. James Pl., and Cookman Ave. Estimated cost $500,000. L. Kaplan, 615 West State St., Trenton, is architect.

N. J., Camden—Apartments Inc., E. G. Hitchner, Pres., 51 Meckle St., plans the construction of a 14 story apartment building at Seventh and Cooper Sts. Estimated cost $1,000,000. H. N. Moffett, 104 Market St., is architect.

N. J., Ridgewood—North Oak Improvement Co., North Broad St., will readvertise for bids for the construction of a theatre and office building including steam heating system, etc. at Oak St. and Franklin Ave. Estimated cost $500,000. P. A. Vivarttas, 110 48th St., Union City, N. J., is architect.

N. Y., Albany—Bd. of Contract & Supply, P. J. Manweller, Secy., City Hall, will soon award contract for the superstructure of a filtration plant and pumping station.

N. Y., Brooklyn—Beth Moses Hospital, is having plans prepared for addition to hospital at 404 Hart St. Estimated cost $1,000,000. C. Mayer, 31 Union Sq., is architect.

N. Y., Brooklyn—St. Johns College, 75 Lewis Ave., is having plans prepared for a 12 story law school building at Boerum Pl. and Schermerhorn St. Estimated cost $1,000,000. J. F. Cook, 9 Clinton Pl., Newark, N. J., is architect.

N. Y., New York—American Museum of Natural History, H. F. Osborn, Pres., is having plans prepared for a 5 story museum at Columbus Ave. and 77th St. Estimated cost $2,500,000. Trowbridge & Livingston, 527 5th Ave., are architects.

N. Y., New York—Five Hundred Park Ave. Corp., J. H. Carpenter, Pres., 551 5th Ave., had plans prepared for the construction of an 11 story apartment building at 14-18 East 90th St. Estimated cost $700,000. J. E. R. Carpenter, 598 Madison Ave., is architect.

N. Y., New York—L. N. Hartog, 214 East 22nd St., plans the construction of a 16 story loft building at Second Ave. and 21st St. Estimated cost $1,000,000. I. M. Fenichel, 114 East 32nd St., is architect.

N. Y., New York—Highbridge Realty Corp., N. H. Schenck, Pres., had plans prepared for a theatre and stores building at 4140 Broadway. Estimated cost $1,250,000. T. W. Lamb, 644 8th Ave., is architect.

N. Y., New York—R. Paley, 510 East 89th St. and R. Niles, Jr., 222 East 49th St., had plans prepared for a 15 story apartment building at 1737 Ave. A. Estimated cost $1,000,000. J. E. R. Carpenter, 598 Madison Ave., is architect.

N. Y., New York—Three Hundred Twenty Two East Fifty Seventh St. Corp., M. M. Sullivan, Pres., 631 Park Ave., had plans prepared for a 21 story hotel at 322 East 57th St. Estimated cost $700,000. Caughey & Evans, 29 West 34th St., are architects.

N. Y., New York—Tudor City Ninth Unit, E. Monroe, Pres., 350 Madison Ave., will build a 58 story hotel at 40th to 41st Sts. and First Ave. Estimated cost $6,000,000. F. F. French Co., 350 Madison Ave., is architect. Work will be done by separate contracts.

N. Y., New York—W. A. R. Realty Corp., M. F. Huberty, Pres., had plans prepared for a 36 story hotel at 958-76 6th Ave. Estimated cost $4,050,000. G. B. Post & Sons, 101 Park Ave., are architects.

N. C., Greensboro—Greensboro Ice & Fuel Co. plans the construction of an ice plant on Prescott St.

N. C., Sanford—Newman Ice & Coal Co., P. Newman, Raleigh, plans the construction of an ice plant here.

N. C., Sanford—Sanford Ice & Coal Co. plans the construction of an ice plant to replace plant recently destroyed by fire.

O., Cincinnati—F. M. Erwin, 900 Neave Bldg., plans the construction of an 8 story apartment building at Hackberry St. Estimated cost $650,000. J. S. Adknis, 15 East 8th St., is architect.

Pa., Philadelphia—Peyton Realty Co., c/o Integrity Trust Co., 717 Chestnut St., awarded contract for a 23 story bank and office building at 16th and Walnut Sts. to George Fuller Co., Morris Bldg.

Pa., Philadelphia — Y. M. C. A., 1421 Arch St., awarded contract for a 26 story addition to building at 15th, Olive and Arch Sts., to Irwin & Leighton, 1545 Race St. Estimated cost $1,500,000.

Pa., Pittsburgh—P. M. Jullien, Edmonds Bldg., Washington, D. C., Archt., will soon award contract for the construction of a 9 story apartment building including steam heating and refrigeration systems, elevators, etc. here. Estimated cost $1,000,000. Owners' name withheld.

Pa., York—York Hospital, plans the construction of a hospital. Estimated cost $1,000,000. Ballinger Co., 12th and Market Sts., is architect.

S. C., Myrtle Beach—Myrtle Beach Sales Co., J. T. Woodside, Pres., plans the construction of Ocean Forest Hotel. Estimated cost $1,000,000. S. S. Johnson and R. O. Brannon, Lynchburg, Va., are architects.

S. D., Sioux Falls—City plans an election Apr. 17 to vote $100,000 bonds for extensions and improvements to light plant to increase the capacity.

Texas and Mexico—International Water Commission, United States and Mexico, plans to install dams along the Rio Grande River for impounding water for irrigation and hydro-electric plants. Upon completion of surveys, plans, etc. same will be made basis of a treaty between United States and Mexico after which actual construction will start. Estimated cost approximately $15,000,000. W. E. Anderson, San Benito, Tex., and Gustavo P. Serrano, Juarez, Mexico, are engineers.

Tex., Brownsville—Water Control & Improvement Dist., c/o Point Isabel Irrigation Co., had surveys made for irrigating approximately 1,200 acres of land in share No. 32, Cameron county including the installation of a pumping plant on Rio Grande River.

Tex., Graham—City plans an election Apr. 10 to vote $225,000 bonds for waterworks improvements including dam, pumping plant, mains, etc.

Ont., Ayr—Canadian Pacific Ry., Windsor Station, Montreal, Que., plans to replace present steam pumping plant with an electric pump here. J. M. R. Fairbairn, is chief engineer.

Ont., Leaside — Ontario Hydro Electric Power Commission, Toronto, awarded contract for the construction of a transformer building, here.

Ont., Toronto—Canada Permanent Mortgage Corp., 14 Toronto St., plans the construction of a 16 story office building, including steam heating system, electric elevators, etc., at Bay and Adelaide Sts. Estimated cost $500,000. F. H. Wilkes and Mathers & Haldenky, 96 Bloor St. W., are architects. Sproatt & Rolph, 1162 Bay St., are consulting architects.

Ont., Windsor—Greater Windsor Development Co., Exchange Bldg., is having revised plans prepared for a 30 story hotel including steam heating system, electric elevators, etc., at Daugall and London Sts. Estimated cost $2,000,000. Trace & Diehle, 23 Pitt St. W., are architects.

Equipment Wanted

Air Compressor—Bd. of Chosen Freeholders, G. C. Bergen, Purch. Agt., Room 524, Hall of Record Bldg., Newark, N. J., will receive bids until Apr. 10 for a portable air compressor.

Air Compressor, Pump, Engine and Generator—J. H. Osborn, Clk., San Bernardino, Calif., will receive bids until Apr. 9 for an air compressor, pump, gas engine and generator, etc. for proposed sewage treatment plant.

Condenser and Pumps — U. S. Engineer Office, Milwaukee, Wis., will receive bids until April. 16, for one surface condenser, one steam driven centrifugal pump and one air pump.

Engine and Generator, Pumps, Etc.—City of Mount Clemens, Mich., plans to purchase a 150 kva. oil engine and generator, motor driven centrifugal pumps, etc. for proposed waterworks improvements.

Hoist, Engines, Etc.—T. F. Farrell, Comr. of Canals & Waterways, Albany, N. Y., will receive bids until Apr. 10 for one motor driven hoist, one 500 B.H.P. Diesel engine direct connected to 15 in. centrifugal dredging pump and one 150 B.H.P. Diesel engine direct connected to kw. generator at Barge Terminal, Syracuse, N. Y.

Power Plant Equipment—Penal Institutions Dept., P. A. Chapman, Comr., Boston, Mass., will receive bids until Apr. 9 for equipment for proposed power plant at Deer Island, Boston Harbor.

Pumping Equipment—City of Holtville, Calif., plans to purchase pumping equipment etc. for proposed waterworks improvements.

Pump, etc.—Division of Standards & Purchases, Executive Dept., F. R. Uttor, Supt., Collins, N. Y., will receive bids until Apr. 19 for a pump, etc., for Thomas Indian School, Iroquois, Collins, N. Y.

Pump, Engine, etc.—Bd. of Water Comrs., Marshfield, Mass., will receive bids until Apr. 10 (extended date), for furnishing and installing two duplicate pumping units each consisting of a 10 x 12 in. vertical triplex deep well pump and 50 hp. Diesel engine for proposed puming station.

Pumping Equipment — Common Council, Mott, N. D., will receive bids in April for equipment for waterworks including electrically driven pumping machinery, etc. E. R. Griffin, is engineer.

Pumps — Quartermaster, Third Corps Area, Baltimore, Md., will receive bids until Apr. 13, for furnishing and installing a deep well pump at Fort Hunt, Va.

Pumps, Etc.—P. Allard, Clk, Lochmoor Village, Mich., will receive bids until Apr. 5 for two electric motor driven centrifugal pumps with accessories for proposed sewage treatment work.

Industrial Projects

Ark., Malvern—TEXTILE MILL—International Shoe Co., 1501 Washington Ave., St. Louis, Mo., will build a textile mill here. Estimated cost $1,000,000. Private plans. Work will be done by owners forces.

Colo., Pueblo—AIRPLANE FACTORY—A. P. Devore, 810 Palmer Ave., plans the construction of a factory to manufacture airplane engines and airplanes. Estimated cost $100,000.

Colo., Pueblo — MINERAL GRINDING and DRYING PLANT—Metalloid Corp., c/o D. H. Palmer, 53 West Jackson Blvd., Chicago, Ill., plans to expend approximately $300,000 during the next two years to increase the capacity of their plant. Machinery, motors, etc., will be required.

Conn., Thomaston—CLOCK FACTORY—Seth Thomas Clock Co., Elm St., awarded contract for a 4 story, 60 x 100 ft. factory to T. J. Pardy Construction Co., 1482 Seaview Ave., Bridgeport. Estimated cost $125,000.

Ill., Chicago—FELT FACTORY—Allied Industrial Products Co., 120 North May St., manufacturers of felt goods, awarded general contract for a 3 story, 40 x 106 ft. factory at Elizabeth St. and Washington Blvd. Estimated cost $50,000.

Ill., Chicago—PLUMBING AND HEATING SUPPLY FACTORY—Capitol Plumbing & Heating Supply Co., 731 North Wells St., awarded contract for a 2 story factory and warehouse at Clybourn, Ashland Ave. and Chester St. to Christensen Construction Co., 2066 North Cicero Ave. Estimated cost $100,000.

Ind., South Bend—BALL BEARING FACTORY—Bantam Ball Bearing Co., West Sample St., awarded contract for a 1 story, 100 x 200 ft. factory to H. G. Christman, 306 Notre Dame St. Estimated cost $50,000.

Me., Rumford—PAPER MILL—Oxford Paper Co., 200 5th Ave., New York, N. Y., awarded contract for the construction of addition to paper mill, to J. Kerr. Estimated cost $125,000.

Mass., Watertown (Boston P. O.)—PRESSED METAL FACTORY—Peerless Pressed Metal Co., 14 Electric Ave., Brighton, will soon award contract for a 1 story, 80 x 200 ft. factory here. Estimated cost $40,000. Private plans.

Mass., Webster—AUTO BODY FACTORY—Watertown Co., Tracy Court, will build a 2 story, 70 x 95 ft. factory. L. J. Chafee, Oxford, is architect. Work will be done by separate contracts.

Mich., Bay City—AUTOMOBILE FACTORY—Chevrolet Motor Car Co., Flint, awarded contract for a 1 story, 225 x 900 ft. automobile factory on North Madison St. here. to H. G. Christman Co., Lansing. Estimated cost $450,000.

Mich., Detroit—SEAL AND STAMP FACTORY—Superior Seal & Stamp Co., 151 East Jefferson Ave., awarded contract for a 2 story, 75 x 130 ft. factory at Porter and Vermont Sts. to C. S. Barry Co., 2631 Woodward Ave. Estimated cost $70,000.

Mich., Saginaw—FOUNDRY ADDITION—Saginaw Malleable Iron Works, awarded contract for a 1 and 2 story, 82 x 90 and 40 x 80 ft. additions to foundry for core building and sand storage on Florence Ave. to The Austin Co., General Motors Bldg., Detroit.

Mo., St. Louis—PAPER PLANT—The Waxide Paper Co., 20th and Tracy Sts. and Berkowitz Ave., Kansas City, is having preliminary plans prepared for a 1 story, 150 x 280 ft. plant for the manufacture of wax paper with paraffin as base at Race Course and Newstead Aves. here. Estimated cost $250,000.

Tex., Port Aransas—CEMENT PLANT—Monolith Portland Cement Co., c/o C. Burnett, Bartlett Bldg., Los Angeles, Calif., plans the construction of a cement plant on Harbor Island near here. Estimated cost $600,000. Private plans.

Ont., Walkerton — WOODWORKING PLANT—R. E. Truax & Son, manufacturers of kitchen cabinets, built in cupboards, etc. will soon receive bids for a 2 story, 80 x 100 ft. plant. Estimated cost $50,000. Private plans.

Ont., Toronto—STEEL FABRICATING SHOP—Reid & Brown Structural Steel & Iron Works, 63 Esplanade St. E., plans the construction of a structural steel fabricating shop on Fleet St. Estimated cost $200,000. Private plans.